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Synergy between resilience and empathy in health sciences students: a cross-sectional study

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Abstract

Background Empathy is considered a key factor in patient satisfaction, treatment adherence, clinical outcomes, and professional fulfillment. Consequently, training health sciences students in empathy has become a priority in universities worldwide. However, empathy-focused interventions have not achieved the desired success due to the complex nature of empathy. Both internal and external factors shape and influence empathy. Resilience has been proposed as one such factor, but the association between these two concepts is poorly understood. This study aims to evaluate the association between different dimensions of resilience and empathy in health science students.

Methods A Cross-sectional analysis evaluated the levels of empathy and resilience in 993 Medical, Nursing, and Dentistry students at Universidad del Norte using the Jefferson Scale of Empathy-Health Professions Students (JSE-HPS) and the Ecological, Engineering, Adaptation (EEA) Resilience Scale. Data were examined through univariate and multivariate normality analyses and descriptive statistics. To evaluate the theoretical structure of empathy and resilience, a confirmatory factor analysis (CFA) was performed on the three-dimensional models of each construct. Reliability was established using the Omega coefficient. Finally, structural equation modeling (SEM) with a robust maximum likelihood estimator was applied to analyze the association between resilience and empathy.

Results The normal distribution assumptions were largely met for empathy scale data, its respective dimensions, and individual items. The theoretical model was well-supported for both constructs, and the data suggested acceptable reliability. SEM analysis revealed that the association between empathy and resilience dimensions vary. Ecological resilience was positively correlated with all empathy dimensions while engineering and adaptative resilience were negatively correlated with all three dimensions of empathy.

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Conclusions There is no universal effect of resilience on empathy. Designers of empathy-focused educational interventions and researchers should consider the potential differential effects of different dimensions of resilience on different aspects of empathy. In particular, focusing on ecological resilience may create the conditions for achieved empathy to be expressed, while strategies to mitigate the potential negative impact of adaptive resilience on empathy should be further explored.

Keywords Adaptability, Compassion, Prediction, Confirmatory factor analysis, Structural equation modeling, Empathy, Resilience

Background

Empathy in healthcare is important for providing quality care, enabling professionals to internalize patients suffering [1]. Higher physician empathy is correlated with increased patient satisfaction, lower levels of anxiety, improved physician-patient communication, and better health outcomes such as improved glycemic control, better lipid profile, shorter duration of infections and improved pain [2–6]. Beyond these objective outcomes, empathy is also critical for navigating the complexities of patient subjective self-reporting. For instance, clinical experience teaches students that pain severity does not necessarily translate into disease severity. In such cases, empathy is particularly important for maintaining sensitivity and respect to patients' personal experience of pain regardless of clinical relevance [7]. The benefits of empathy in clinical practice have sparked growing interest in empathy training for health science students in the US, Europe and Latin America, with a systematic review supporting its effectiveness [8].

International frameworks for developing competencies in health students have included empathy as an important attribute for interprofessional collaborative practice and health professionals' capabilities [9, 10]. Health science students are at risk of stress, depression, and burnout, which can lead to a decrease in empathy, or worse, empathic erosion [11]. Functional magnetic resonance has linked burnout severity to reduced empathy-related brain activity [12] while resilience, defined as the ability to withstand stress, is negatively associated with burnout [13]. This suggests resilience might act as a stress buffer and protect empathic responses in health students. In this sense, it is no surprise that resilience is also mentioned as an important attribute for health professionals in international competence frameworks [9, 10].

Empathy training shows promise for enhancing health care practice, yet it is unclear what factors could improve its effectiveness [8]. Previous research has explored the correlation between resilience and empathy in cross-sectional analysis [11, 14–20]. A positive correlation between empathy and resilience has been reported in patients [14], health professionals [15], and university students [16–20]; studies in healthcare students have focused specifically on the relationship between resilience and empathy; for example, in China [17, 18], in El Salvador [11, 19] and in Pakistan [20]. However, few works have studied this relationship in terms of how the dimensions of resilience are associated with the dimensions of empathy [11, 19]. Studies conducted in China are not directly interested in the influence of resilience dimensions as underlying factors influencing empathy dimensions. Rather, their interest lies on the mediating effect of resilience between empathy and learning burnout [17] or, empathy and professional identity [18]. The Pakistan study specifically aimed at exploring the relationship between resilience and empathy and reported a positive weak correlation (r =.208) between the two constructs in medical students [20]. These three studies measured resilience as a latent variable using the Connor-Davidson Resilience Scale (CD-RISC). The CDR-RISC is one among five traditional scales measuring trait resilience (Ego Resiliency Scale, the Hardiness Scale, the Psychological Resilience Scale, the and the Brief Resilience Scale). All these scales combined target 9 resilience traits: Control, (Ego Resilience Scale), self-efficacy (Hardiness Scale, CD-RISC) commitment (Hardiness Scale, CD-RISC), embracing challenge (Hardiness Scale, CD-RISC), a purposeful life, perseverance, self-reliance, equanimity, and existential aloneness (Psychological Resilience Scale). In contrast, the studies in El Salvador measured a theoretically grounded resilience process based on Engineering, Ecological, and Adaptive (EEA) approach to resilience [21], and not only associated traits on an individual scale [18]. The EEA theoretical framework for measuring resilience is derived from the five scales and represents an overall abstraction of the scale dimensions with the EEA theoretical labels, which represent key dynamics in interdisciplinary resilient systems [21]. The Engineering Ecologic Adaptative (EEA) scale assesses *Engineering Resilience (ENG): Examine* how well a system can return to normal after disruption. *Ecological Resilience (ECO)*: Evaluates a system's capacity to withstand or resist disturbances while adjusting its response to remain stable. *Adaptive Resilience (ADA)*: Refers to the ability to manage changes and adapt to current disruptions [21]. The EEA has demonstrated validity and reliability [11, 21].

Empathy is a complex concept involving primarily cognitive and emotional dimensions [22–28]. The cognitive aspect refers to the ability to understand another's

feelings and adapt their perspective, setting aside one's own to attribute a mental state [22]. The emotional dimension considers empathy as a shared feeling: ".the emotional reaction of an observer perceiving another person experiencing or about to experience an emotion" [22, 28]. Current practice recommends the use of a multidimensional measurement of empathy [28, 29]. The Jefferson Scale of Empathy for Health Professions Students (JSE-HPS) is known for its reliability, validity, and stability, and it comprises three dimensions—perspective-adoption, compassionate care, and "walking in the patient's shoes"—that evaluate both the cognitive and emotional aspects [28, 29].

To the best of our ability, we do not know of any formal psychological theory that explicitly links resilience as a predictor of empathy [19]. However, the findings of the above-mentioned previous research suggest an emergent association between the two constructs in particular populations and context. As a formal theory emerges, it is important to explore the relationship between the two constructs. In the absence of a theory, ensuring the structural validity of the constructs is one of the three suggested steps to sound psychological theorizing [30]. Based on prior research with health students in El Salvador, Fig. 1 presents a theoretical framework that connects these concepts and their dimensions [11, 19].

Two studies employing Structural Equation Modeling (SEM) El Salvador found that the Engineering dimension negatively predicted Perspective Taking, while the Ecological dimension positively predicted both Perspective Taking and Compassionate Care, and the Adaptive dimension negatively predicted Compassionate Care [10, 18]. However, it remains an open question whether these findings are replicable in other universities and countries. In this context, we reasoned that in a different university of Latin America, different dimensions of resilience should also correlate differently with different dimensions of empathy and that the correlation would follow the same patters found in the Salvador Study. Therefore, the aim of the present study is to (i) evaluate the association between different dimensions of resilience and empathy in health science students and (ii) test weather similar effect coefficients results are found between different dimensions of resilience and empathy in a different university and country, at Universidad del Norte in Barranquilla, Colombia. The results of this study would contribute to our understanding of the cross-cultural stability of the relationship between the two constructs and potentially, which dimensions of resilience are important to promote in health students to develop specific empathic skills. In addition, the findings could hint that potential strategies for effective empathy training through targeting resilience could work across universities and cultures.

Materials and methods

Design and population

This study was non-experimental and cross-sectional. Resilience was considered the independent variable and empathy the dependent variable. The population consisted of Medical, Nursing, and Dentistry students from Universidad del Norte in Barranquilla, Colombia. Universidad del Norte delivers instruction for all three programs at the same physical location, with a significant proportion of students attending classes across the three programs simultaneously. This pattern extends to clinical areas, as the university has its own hospital where students in these programs share a common clinical space. Inclusion criteria imply voluntarily expressing the desire to participate in the study and signed informed consent form. Students were evaluated in classroom settings during formal academic hours using an online questionnaire. The instruments were administered by trained instructors who ensured voluntary participation. Data collection was confidential, with only researchers from Universidad del Norte knowing the students' identities. Personal information was retained for three months to allow participants to withdraw their data. Any personal

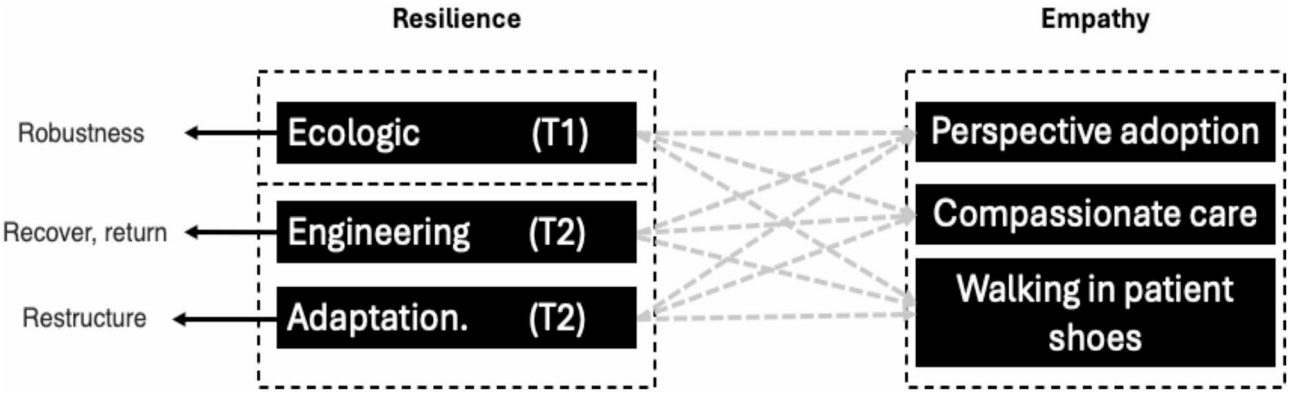

Fig. 1 Theoretical connections between resilience and empathy dimensions. Self-made based on [11, 19]

information was removed, and the data was anonymized during data sharing with team members and after the three-month period.

This research was approved by the Directorate of Research, Development, and Innovation of Universidad del Norte in June 2022 and by the Ethics Committee of the Health Sciences Division of Universidad del Norte (Act No. 269, June 2022). Students under 18 years of age participated after obtaining parental consent. According to the Colombian Government Resolution 8430 of 1993, which establishes scientific, technical, and administrative standards for health research in Colombia, this study was classified as minimal risk. The data set collected for this study is available on the OSF platform, which can be accessed through the following link: https://osf.io/n5zq6/?view_only=158be12ac0ed43e6ad137d42eefad0b6.

Instruments

Sociodemographic variables

Four sociodemographic variables were collected as part of the study: academic program, gender, age, and current academic year.

Resilience

EEA Trait Resilience Scale (EEA) [21]. This scale evaluates three facets of resilience: engineering, ecological, and adaptive resilience (EEA). It is a 12-item Likert scale with five response levels ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). The scale measures three dimensions of resilience (i) Engineering (ENG): Items 1, 2, 3, 4 e.g., *"I am able to recover from stressful events with ease"* or *"I can quickly return to my normal state after problems in my life"* (ii) Ecological (ECO): Items 5, 6, 7, 8 e.g., *"I always give everything I can, despite what may happen"* or *"I remain strong, no matter what problems occur"* and (iii) Adaptation (ADA): Items 9, 10, 11, 12 e.g., *"Uncertain situations pique my interest"* or *"I enjoy when there are changes in my routine"*. The Trait Resilience Scale has demonstrated satisfactory internal consistency and test-retest reliability (McDonald's Omega = (0.70–0.86); Cronbach's alpha = (0.68–0.82). Additionally, it features a stable cross-cultural factorial structure, convergent and construct validity concerning associations with personality, and a positive contribution to clinical and non-clinical psychological health states [21]. This instrument is free to use [21].

Empathy

Jefferson Scale of Empathy-Health Professions Students (JSE-HPS) [29]. This instrument was used under license from Asano-Gonnella Center for Research in Medical Education and Health Care Thomas Jefferson University (Order ID: 10905). This scale consists of 20 items that measure levels of empathy towards patients in health sciences students from any specialty. Items are rated on a 7-point response scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). The scale measures three dimensions (i) Compassionate Care (CC): Items 1, 7, 8, 11, 12, 14, 18, 19, e.g., *"Health care providers understanding of their patients' feelings and the feelings of their patients' families does not influence treatment outcomes"* or, *" Health care providers should not allow themselves to be influenced by strong personal bonds between their patients and their family members"* (ii) Perspective-Adoption (PA): Items 2, 4, 5, 9, 10, 13, 15, 16, 17, 20, e.g., *"Health care providers' understanding of the emotional status of their patients, as well as that of their families is one important component of the health care provider - patient relationship"* or *"Health care providers should try to think like their patients in order to render better care"*, and (iii) Walking in Patient's Shoes (WIPS): Items 3 and 6. e.g., *"It is difficult for a health care provider to view things from patients' perspectives"* and *"Because people are different, it is difficult to see things from patients' perspectives"*. The scale has demonstrated adequate internal consistency ($\alpha = 0.78–0.92$) and appropriate correlations with other psychological variables [29].

Statistical analysis

Descriptive univariate normality analyses (skewness and kurtosis) were performed on the levels of empathy (and its dimensions) and each item, as well as multivariate normality (Mardia's test) for both instruments. Confirmatory Factor Analysis (CFA) using the robust maximum likelihood estimator (MLR) was applied to the empathy scale since its items have 7 response options, allowing them to be treated as continuous variables [31]. For the resilience scale, the Weighted Least Squares Mean and Variance Adjusted (WLSMV) estimator was used, as it is appropriate for ordinal variables based on the polychoric correlation matrix [32], given the 5 response options per item.

The following cut-off criteria were used for fit indices: CFI > 0.90, TLI > 0.90, RMSEA < 0.08, and SRMR < 0.05 [31, 33]. Reliability was assessed using the Omega coefficient. Cut-off points were also established using percentiles, specifically quintiles [34], to establish five categories. (very high, high, medium, low, very low). After verifying the psychometric properties of the scales, an explanatory model was computed to evaluate resilience as a predictor of empathy using the MLR estimator and Structural Equation Modeling (SEM). The same cut-off criteria described above were applied to assess model fit. A priori power analysis for studies with SEM, employing the recommended minimum effect size of 0.2, statistical power of at least 0.8, 6 latent variables (3 for empathy and 3 for resilience), and 32 observed variables (20 for empathy and 12 for resilience), yielded a result

Table 1 Descriptive statistics of empathy and resilience and their respective dimensions

	Min	Max	M	SD	g1	g2
Empathy	45	140	111,65	13,60	−0,699	0,408
Compassionate care	8	56	42,47	7,74	−1,032	1,478
Perspective adoption	19	70	60,43	7,82	−1,301	2,349
Walking in the patient's shoes.	2	14	8,75	2,77	−0,217	−0,475
Resilience	12	60	44,33	8,82	−0,237	−0,098
Engineering	4	20	14,44	3,89	−0,426	−0,215
Ecology	4	20	16,22	2,99	−0,594	0,123
Adaptation	4	20	13,67	4	−0,309	−0,452

M Media, *SD* Standard, Deviation, *g1* Skewness, *g2* Kurtosis

Table 2 Univariate descriptive statistics per empathy and resilience items

Items	M	SD	g1	g2	Items	M	SD	g1	g2
Empathy Scale									
1	5.14	2.02	−0.83	−0.58	11	5.21	1.67	−0.86	0.01
2	6.58	0.98	−3.17	11.54	12	5.77	1.66	−1.55	1.62
3	4.65	1.58	−0.34	−0.58	13	6.13	1.32	−1.59	1.79
4	6.46	1.00	−2.16	4.69	14	5.94	1.46	−1.70	2.52
5	5.27	1.65	−0.75	−0.20	15	5.71	1.53	−1.00	0.04
6	4.09	1.66	−0.11	−0.73	16	6.17	1.19	−1.55	2.11
7	6.15	1.51	−2.18	4.14	17	5.32	1.59	−0.68	−0.40
8	5.44	1.77	−1.08	0.17	18	3.13	1.70	0.39	−0.76
9	6.12	1.23	−1.38	1.29	19	5.69	1.71	−1.35	0.94
10	6.16	1.16	−1.53	2.28	20	6.50	0.95	−2.12	4.46
Resilience Scale									
1	3.70	1.07	−0.60	−0.20	7	3.98	0.95	−0.75	0.15
2	3.53	1.11	−0.39	−0.56	8	4.07	0.88	−0.74	0.24
3	3.63	1.09	−0.51	−0.33	9	3.60	1.21	−0.54	−0.55
4	3.58	1.11	−0.43	−0.50	10	3.20	1.30	−0.13	−1.07
5	4.23	0.85	−0.85	0.15	11	3.33	1.25	−0.31	−0.90
6	3.94	0.98	−0.66	−0.22	12	3.53	1.26	−0.51	−0.73

M Media, *SD* Standard Deviation, *g1* Skewness, *g2* Kurtosis

of at least 403 participants to increase the probability of finding true effects. Data analyses were conducted using JASP and R software with its RStudio interface, employing the packages lavaan version 0.6–18, psych version 2.4.3, Sem Tools version 0.5–6, and MVN version 5.9.

Results

The analysis included 993 students evaluated in November 2022, distributed as follows: Nursing = 202 (20.3%), Medicine = 604 (60.8%), and Dentistry = 187 (18.8%). The sample included students from all academic years in the three disciplines, representing 52.9% of the total population ($N = 1881$). Females represented the majority of participants = 650 (65%) and Male = 343 (35%). The mean (M) age of the male students was M = 19.07 years with a standard deviation (SD) of 1.85 years, and for females, M = 19.18 years with an SD of 2.31 years. Descriptive statistics of the constructs of empathy and resilience, as well as each of their dimensions, are presented in Table 1.

In Table 2, it is evident that in the empathy scale, item 2 showed excessive kurtosis (>|7|), which is considered an indicator of severe non-normality [31], however, it was decided to retain this item due to its theoretical relevance to the construct of empathy. This is supported by psychometric literature, which recommends prioritizing theoretical relevance and contribution to reliability in item retention [31]. Meanwhile, the resilience scale displayed expected values. Additionally, multivariate normality was assessed using Mardia's test, which confirmed that neither scale met the condition of multivariate normality ($p < .001$).

The original 3-factor correlated model of empathy was tested using the MLR estimator, yielding an adequate fit ($\chi 2 = 502.05$; df = 167; CFI = 0.90; TLI = 0.90; RMSEA [90% CI] = 0.045 [0.041 – 0.049]; SRMR = 0.05). However, item 18 displayed a factor loading much lower than the others (0.10). Despite this, it was retained in the model to preserve the original author's structure.

In terms of reliability, the omega coefficient showed indices of 0.72, 0.81, and 0.65 for the dimensions "compassionate care," "perspective-adoption," and "walking in the patient's shoes," respectively. The cut-off points of the

JSE scale were calculated to classify participants based on their scores: Compassionate care: Very low (7,–37), low (38,–42), medium [43,–46], high (47,–49), very high (50,–56], Perspective-adoption: Very low (7,–55), low (56–60), medium (61–63), high (64–67), very high (68–70) and Walking in the patient's shoes: Very low (2–6), low (7–8), medium (9–10), high (11), very high (12–14).

For resilience, the original 3-factor correlated model was tested using the WLSMV estimator, yielding an acceptable fit ($\chi2 = 471.86$; df = 51; CFI = 0.98; TLI = 0.98; RMSEA [90% CI] = 0.09 [0.08 – 0.09]; SRMR = 0.04). In the case of the EEA scale, the reliability assessed with the omega coefficient yielded indices of 0.92, 0.84, and 0.82 for the dimensions "engineering," "ecological," and "adaptive," respectively. The cut-off points for resilience factor scores were as follows: Engineering resilience: Very low (4–12), low (13–14), medium (15–16), high (17–18), very high (19–20), Ecological resilience: Very low (4–14), low (15–16), medium (17), high (18–19), very high (20) and, Adaptive resilience: Very low (4–10), low (11–13), medium (14–15), high (16–17), very high (18–20). Finally, Table 3 shows that gender invariance was only demonstrated for the resilience instrument, but not for empathy.

Explanatory model

Table 4 provides descriptive statistics and correlations for the study variables. It was observed that the resilience dimensions "engineering" ($r = -.10$, $p < .01$), "adaptative" ($r = -.05$, $p < .01$), and overall resilience ($r = -.12$, $p < .01$) negatively correlated with the empathy dimension "compassionate care." In contrast, the resilience dimensions "engineering" ($r = .11$, $p < .01$), "ecological" ($r = .18$, $p < .01$), and overall resilience ($r = .13$, $p < .01$) positively correlated with the empathy dimension "perspective-adoption." Finally, the resilience "adaptive" dimension ($r = -.06$, $p < .01$) negatively correlated with the empathy dimension "walking in the patient's shoes. Multivariate normality was evaluated using Mardia's test, which confirmed that the data did not exhibit this condition ($p < .001$).

The structural model (See Fig. 2) achieved adequate fit indices ($\chi2 = 1177.593$; df = 449; $p < .001$; CFI = 0.92; TLI = 0.92; RMSEA = 0.04 [90% CI 0.038–0.043]; SRMR = 0.04. Notably, although item 18 on the empathy scale showed a factor loading far below expectations, it was retained to preserve the original proposed structure. Ecological resilience dimension positively and significantly predicts all dimensions of empathy. Conversely, the adaptive resilience dimension negatively and significantly predicts all dimensions of empathy. The engineering resilience dimension, however, did not have any significant effects on any variables.

Discussion

The Ecological (ECO) and Adaptive (ADA) dimensions of resilience were found to be statistically significantly associated with empathy. The ECO dimension exhibited a positive association with all measured dimensions of empathy, whereas the ADA dimension was negatively associated with them. The strongest protective association of ECO was with PA, which could help students retain some of their cognitive ability to understand and anticipate patient behaviours and reactions in the presence of stressors. Assuming empathy tends to decrease in health students during formation years, fostering ECO could also aid counteract empathic erosion through improving (to a lesser degree) CC and WIPS [35–37]. Thus, fostering resilience and empathy together could have a potential to generate a synergy that improves quality care and health outcomes.

The ADA dimensions of resilience showed a negative association with all empathy dimensions, having the strongest effect on CC, a marker for emotional empathy. Comparable results were reported previously in two studies in El Salvador [11, 19]. The negative association of ADA with all empathy dimensions was an expected finding, as it aligned with the hypothesis of comparable results to the El Salvador studies. However, this finding is counterintuitive relative to the broader literature, where overall positive correlations between empathy and resilience have been reported [17, 18]. A potential

Table 3 Gender invariance of empathy and resilience

Empathy								
Nivel	X2 (gl)	*p*	CFI	ΔCFI	TLI	RMSEA	ΔRMSEA	SRMR
Configural	699.76 (334)	< 0.001	0.896		0.882	0.047		0.053
Metric	733.72 (351)	< 0.001	0.891	− 0.005	0.882	0.047	0	0.058
Scalar	801.16 (368)	< 0.001	0.877	− 0.014	0.873	0.049	0.002	0.060
Strict	863.69 (388)	< 0.001	0.865	− 0.012	0.868	0.050	0.001	0.066
Resilience								
Configural	518.84 (102)	< 0.001	0.981		0.976	0.091		0.042
Metric	476.99 (111)	< 0.001	0.984	0.003	0.981	0.082	− 0.009	0.045
Scalar	557.19 (144)	< 0.001	0.982	− 0.002	0.983	0.076	− 0.006	0.042
Strict	557.19 (144)	< 0.001	0.982	0	0.983	0.076	0	0.042

Table 4 Descriptive statistics and correlations between variables

	Min	Max	M	SD	g1	g2	1	2	3	4	5	6	7
1. ENG	4	20	14.44	3.90	−0.42	−0.23							
2. ECO	4	20	16.22	2.99	−0.59	0.11	0.62**						
3. ADA	4	20	13.67	4.00	−0.31	−0.46	0.40**	0.45**					
4. RES	12	60	44.33	8.82	−0.24	−0.11	0.83**	0.81**	0.78**				
5. CC	8	56	42.47	7.74	−1.03	1.46	−0.10**	−0.05	−0.14**	−0.12**			
6. PA	19	70	60.43	7.82	−1.30	2.32	0.11**	0.18**	0.05	0.13**	0.33**		
7. WIPS	2	14	8.75	2.77	−0.22	−0.48	0.01	0.04	−0.06*	−0.01	0.34**	0.04	
8. EMP	45	140	111.65	13.60	−0.70	0.39	0.01	0.08**	−0.07*	0.01	0.83**	0.77**	0.42**

ENG Engineering, *ECO* Ecological, *ADA* Adaptation, *RES* Resilience, *CC* Compassionate care, *PA* Perspective adoption, *WIPS* Walking in the patient's shoes, *EMP* Empathy, *M* Mean, *SD* Standard deviation, *g1* Skewness, *g2* Kurtosis

*p <.05, **p <.01

explanation lies in the way resilience is measured in our study. ADA is a distinct aspect of resilience compared to previous studies using the CD-RISC scale, which focus on tenacity, optimism, strength and self-improvement [17, 18]. These four constructs are conceptually more closely related to ECO than ADA, which is consistent with the positive correlation found in our sample between ECO and empathy.

Two underlying theoretical mechanisms could explain the unexpected findings, (i) cognitive load theory and (ii) cognitive trade-offs. Psychological load refers to the mental effort required for a task. The connection between task complexity and an individual's mental capacity to meet the task requirements results in different psychological loads when different individuals approach the same task [38, 39]. Cognitive load theory posits that learning effectiveness is influenced by mental effort. Negative effort is represented by *intrinsic load*, the inherent difficulty of the material itself and *extraneous load*, the wasteful mental effort caused by poor instructional design. Positive effort is represented by *germane load* representing the productive effort invested in constructing meaningful schemas [40]. Cognitive trade-offs are compromises of a cognitive system to the allocation of finite cognitive resources, for instance robustness favors stability, but imply accepting rigidity and a reduction in cognitive flexibility, while cognitive flexibility could promote distractions [41, 42].

The combination of cognitive load theory and cognitive trade-offs could aid contextualizing our findings. When cognitive load increases due to various mental demands, e.g. task complexity, compensatory mechanisms may emerge between different psychological traits [41]. It could be possible that ADA and ENG requires a higher cognitive load than ECO, with proxy measurements for ECO suggesting a weak correlation with intrinsic (r =.3, p <.01) and extrinsic (r =.2, p <.01) cognitive load [38]. Increased ADA could be associated with lower sensitivity; this can reduce susceptibility to stressful situations but may also decrease awareness of positive opportunities (such as being empathic) [42].

A recent systematic review of 16 qualitative studies from international samples offers empirical support for cognitive load and trade-offs playing a role in the association between resilience and empathy [43]. Students reported that intrinsic load such as patients with complex diseases, who no longer communicate or are emotionally taxing, affect their expression of empathy [43]. In addition, extrinsic loads such as organizational culture, administrative policies and the requirement of maintain high performance during long hours, also hindered their ability to express empathy. Furthermore, it was explicitly reported that students employ adaptation mechanisms such as cynicism, desensitization, and professional

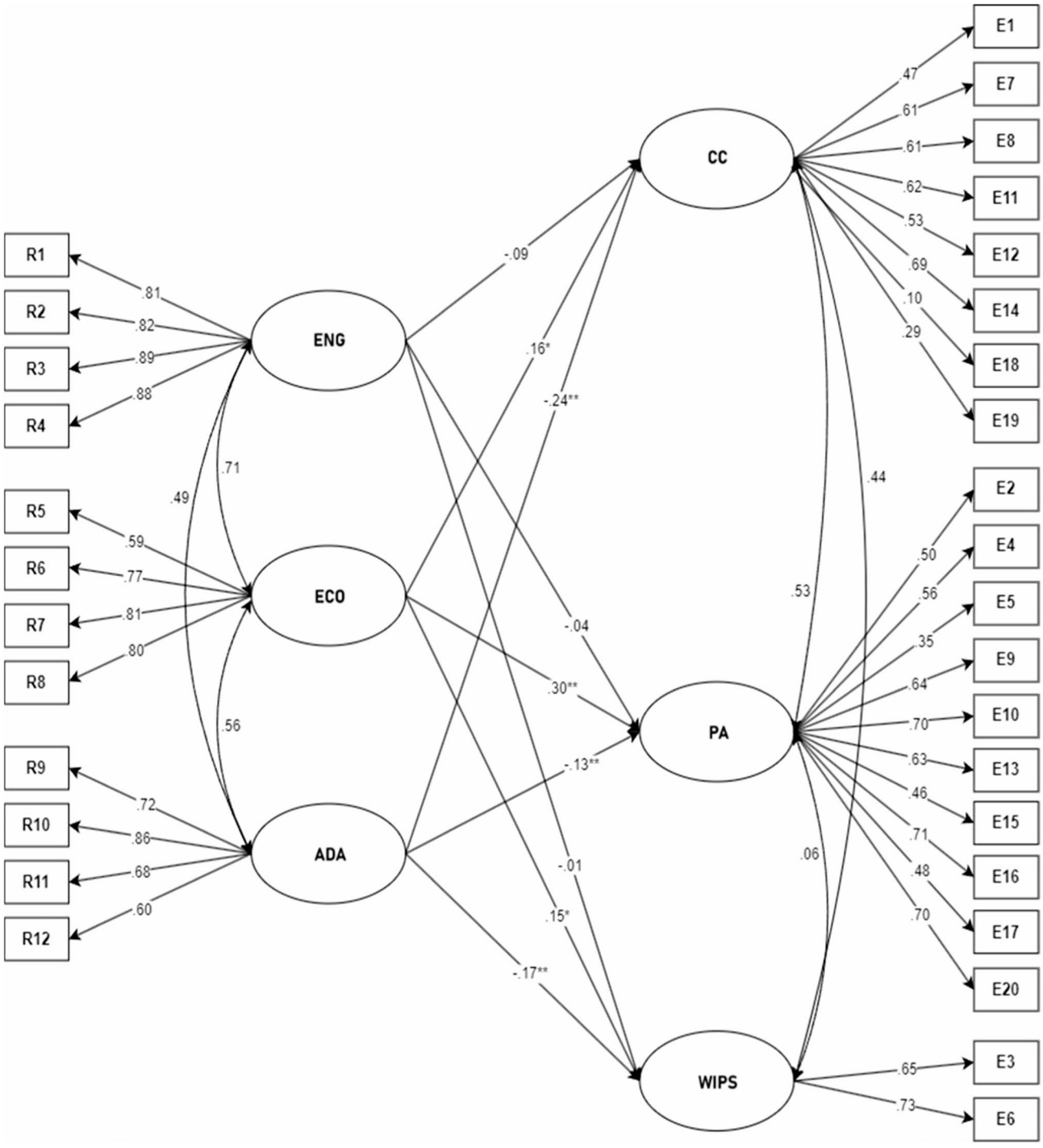

Fig. 2 Explanatory model of resilience factors as predictors of the components of empathy. ENG = Engineering, ECO = Ecological, ADA = Adaptation, RES = Resilience, CC = Compassionate care, PA = Perspective adoption, WIPS = Walking in the patient's shoes

distance to cope with medical school stress and that these affect their ability to be empathetic [43]. Additional research supporting these compensatory mechanisms can also be understood through findings that show increased cognitive load decreases empathy and prosocial behaviour [44].

Different resilience dimensions could be associated with different cognitive loads. There might be cognitive load thresholds that trigger empathic erosion with ADA and ENG more likely reaching these cognitive load thresholds. Actively encouraging teachers and students to identify these thresholds could aid in increasing

self-awareness about intrinsic and extrinsic factors of a learning task that could reduce Compassionate Care to patients. In low cognitive load tasks development resilience could be focused on strengthening ecological resilience such as fostering self-efficacy and goal setting abilities. Targeting ECO might also increase cognitive load, but not to a degree where it could trigger a psychological tradeoff. To begin exploring this relationship while more research is conducted, students could be encouraged to reflect on their cognitive load during various tasks and verbalize how they believe it affects their empathic behavior. This is consistent with suggestions that increasing self-awareness is one of the basic psychological traits of promoting an empathic culture in health care [45]. Such an approach could aid simultaneously to increase ECO and identify potential cognitive load thresholds that activate psychological tradeoffs.

A possible objection to the previous suggestion is that other studies have reported a positive correlation between proxies of ENG and empathy [46], However, these correlations were reported after a 12 days intervention (*"SeRenE"- Stoic Reflection for Resilience and Empathy*) to increase both resilience and empathy and not specifically in a stressful scenario were cognitive load might lead to functional tradeoffs [47]. It is possible that interventions such as the stoic training could improve students cognitive load thresholds that trigger psychological tradeoffs in students. For instance, the use of negative visualizations might prepare students for complex scenarios and reduce their cognitive load when actually facing the situations. Moreover, stoic mindfulness stimulates self-awareness, which might help identify potential cognitive thresholds and provide opportunities to practice cognitive demanding tasks and stop the training before it could result empathy erosion [47].

Multiple quantitative and qualitative systematic reviews outline emerging evidence of potential factors and interventions to promote empathy development. There seems to be two main broad intervention types that enhance empathy. The first is providing information with communication [48], literature about medical humanities [49], empathy, and emotional intelligence courses/workshops [50]. The second is practice-based learning such as early experience with patients in the hospital [51], volunteering, virtual exposition to patients, community work [52], simulation through different means such as; role play, medical manikin, virtual reality, or more recently negative visualizations [47]. Qualitative evidence supports that students that engage in negative visualization within *SeRenE* enhanced their personal resilience by fostering both emotional/practical readiness and cultivated self-control and self-efficacy, key components of resilience [47]. Our findings call for a careful consideration of the idea that empathy interventions should not be integrated to the existing curriculum without considering the interaction with other psychological traits that could be positively correlated with students' cognitive load and trigger functional psychological tradeoffs that hinder empathy. Although evidence synthesis studies support a moderate positive effect of interventions to increase empathy [8], it is plausible that health students' differences in ADA could potentially buffer the impact of these interventions, leading to variations in effectiveness among students. Therefore, more research is critically needed, particularly employing moderator and mediator analyses, to fully understand how empathy training outcomes differ across students with varying levels of ADA and to elucidate the mechanisms underlying these interactions.

The literature suggests that the success of empathy development interventions may be linked to several factors that universities can improve. These factors include the role-modelling of clinical professors and the design of clinical learning tasks (e.g., managing clinically and emotionally complex patients, dealing with organizational culture, and navigating the hidden medical curriculum and academic burden). This highlights the need for research that not only promotes empathic ability in healthcare students but also provides empathy training for university and hospital staff who interact with them. The goal of this training is twofold: to have staff serve as empathic role models and to help them filter out unnecessary complexities that are irrelevant to learning outcomes.

Limitations and strengths

A limitation of the present study is the cross-sectional design and convenience sampling, yet the sample represents approximately 53% of health students at Universidad del Norte. Findings are similar to those found in a previous sample of health students in El Salvador [13, 14], which supports our results are unlikely to be purely caused by chance or selection bias. Nevertheless, further research is needed to assess the causal relationship between resilience and empathy through longitudinal studies that employ random sampling. Whether resilience acts as a factor influencing empathy [53, 54] remains a working hypothesis. Although there are studies on resilience in university students in Latin America [55, 56], they are not generally interested in studying the relationship of resilience and empathy. These studies are also not directly comparable due to (i) different instruments used to measure resilience, (ii) typically reporting "average" resilience levels and (iii) do not evaluate the association of resilience and empathy dimension.

Variability in empathy levels and dimensions across different studies in Latin American nursing [57–59], dentistry [60–62], and medical students [63–66], suggests that variable responses to the association between

empathy and resilience should be expected. The low path coefficient values align with the nature of empathy, as this attribute can be modulated not only by resilience but also by various other factors. Thus, empathy levels depend on the internal nature of empathy itself as well as the modulation of external factors [65, 66]. Although the effects size is low, it is an important contribution on understanding the multiple factors that could influence the effectiveness of empathy development interventions in health students.

One item was found to function inadequately in the empathy instrument, potentially biasing measurements of the associated dimension. Furthermore, since factorial invariance by gender could not be confirmed for either scale, it is not possible to assert that the results apply equally to males and females. Therefore, it would be ideal to verify this in future research and future studies. Similarly, the cut-off points are only referential due to the lack of invariance by gender. but not for empathy. According to Chen [67] the ΔCFI should not exceed –0.01 and the ΔRMSEA should not exceed 0.015. In this sense, interpretations referring to the condition of being male or female should be taken with caution when analyzing empathy by itself. For the resilience instrument, a value of the RMSEA indicates that there might be a more parsimonious model for resilience in students at Universidad del Norte or that there is some degree of miss fit with the data. However, the high CFI, TLI and SRMR values strongly suggest that there is an overall acceptable fit for the EEA resilience scale. Future researchers are encouraged to continue accumulating evidence on the performance of these instruments to ensure the most accurate measurements possible. Finally, some effects sizes are relatively low, it should be kept in mind that the magnitude of an effect does not always reflect its theoretical significance. A small effect may be consistent with existing theories and, therefore, be significant in exploring and validating theoretical models. Indeed, Lakens [68] emphasizes effect sizes are critical for communicating the practical significance of results and facilitating cumulative science.

The psychometric properties of the resilience and empathy scales confirmed that their theoretical dimensions are valid and have acceptable reliability within our sample, which allowed for the measurement of both constructs and their underlying dimensions. Our findings, consistent with prior cross-national studies, provide initial cross-cultural support for the relationship between empathy and resilience. Despite the weak bivariate correlations, the use of Structural Equation Modeling (SEM) was justified as it allowed for the simultaneous testing of complex hypothesized relationships, accounted for multivariate measurement error (which can contribute to weak observed correlations), and offered a more nuanced and visually understandable insight into the underlying structure of these relationships than a basic correlation matrix.

Conclusion

Varying resilience dimensions were associated with empathy dimensions at Universidad del Norte. This confirms findings from two previous studies at a University in El Salvador. While global validation and mechanistic research are needed, initial evidence suggests tailored resilience training could enhance empathy interventions. This is especially relevant for health science students transitioning to a demanding workplace-based clinical learning, a phase associated with the lowest empathy levels among health students [69, 70].

For researchers, a key message is that future studies should explore the cognitive load associated to different dimensions of resilience. It would also be valuable to evaluate whether cognitive load thresholds exist and how specific educational interventions, such as stoic training, might moderate the effects of resilience on cognitive load or the relationship between cognitive load and empathy. Additionally, further research is needed to understand how empathy training outcomes vary among students with different levels of Adaptive resilience (ADA) and to uncover the mechanisms underlying these interactions to fully comprehend the effectiveness of such training. Finally, more research is required to develop a formal theory linking these constructs and their dimensions, ideally using a longitudinal design.

Abbreviations

aMCC	anterior mid-cingulate cortex
AI	Anterior insula
ADA	Adaptative Resilience
PA	Perspective Adoption
CC	Compassionate Care
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
ΔCFI	Delta Comparative Fit Index
CD-RISC	Connor-Davidson Resilience Scale
dACC	dorsal anterior cingulate cortex
dmPFC	dorsomedial prefrontal cortex
EEA	Engineering Ecological Adaptive resilience
ECO	Ecological resilience
ENG	Engineering resilience
IPL	Inferior parietal lobule
JASP	Just Another Statistical Program
JSE-HPS	Jefferson Scale of Empathy-Health Professions students
M	Mean
MLR	Maximum Likelihood Estimation Robust
mPFC	medial prefrontal cortex
RMSEA	Root Mean Square Error of Approximation
Δ RMSEA	Delta Root Mean Square Error Approximation
SD	Standard Deviation
SeRenE	Stoic Reflection for Resilience and Empathy
SEM	Structural Equation Modeling
SRMR	Standardized Root Mean Square Residual
STS	Superior temporal sulcus
TLI	Tucker-Lewis Index
TPJ	Temporo-parietal junction
vmPFC	ventromedial prefrontal cortex

WIPS	Walking in the Patient's Shoes
WLSMV	Weighted Least Squares Mean and Variance adjusted

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VD-N, JG-M, LWVQ, AR-R, JER and FR-R contributed to the idea and methodological design. LMAP, JBG, RPSM, ERC-R, SC, JAC, JSS, ARSJ, ALRG, AECB, JER, DVSM, YFM, OLHR, SEN, OEHB, RC, KV and ZCM contributed to the application of the instruments and data collection. LA, LWV and JG-M contributed to the supervision of the study. JER, JG-M and VD-N substantively edited and revised the final version of the paper. All authors read and approved the final manuscript.

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Data availability
Data is provided within the manuscript or supplementary information files.

Declarations

Ethical approval and consent to participate
The present research was approved by the Direction of Research, Development and Innovation of the Universidad del Norte in June 2022 and by the Research Ethics Committee of the Health Sciences Division of the Universidad del Norte, Act N° 269 in June 2022. The ethics committee that approved this study is governed by the standards established in the Declaration of Helsinki. This committee reviewed and approved the informed consent that was applied to the students. In this consent, the student is asked to give his approval for the data to be processed and the results to be published.

Consent for publication
Not applicable. The manuscript does not contain personal data (details, images or videos).

Competing interests
The authors declare no competing interests.

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References

1. Murakami Y, Hinohara S, editors. Kanja ni natta ishi karano message [Messages from doctor–patients]. Tokyo: Jiyu Kokumin Sha; 2003.
2. Morishita M, Iida J, Nishigori H. Reconstructing the concept of empathy: an analysis of Japanese doctors' narratives of their experiences with illness. Adv Health Sci Educ Theory Pract. 2023;28(1):87–106.
3. Derksen F, Bensing J, Lagro-Janssen A. Effectiveness of empathy in general practice: a systematic review. Br J Gen Pract. 2013;63(606):e76-84.
4. Guidi C, Traversa C. Empathy in patient care: from 'Clinical empathy' to 'Empathic concern. Med Health Care Philos. 2021;24(4):573–85.
5. Canales C, Strom S, Anderson CT, Fortier MA, Cannesson M, Rinehart JB, et al. Humanistic medicine in anaesthesiology: development and assessment of a curriculum in humanism for postgraduate anaesthesiology trainees. Br J Anaesth. 2019;123(6):887–97.
6. Suazo I, Pérez-Fuentes MDC, Molero Jurado MDM, Martos Martínez Á, Simón Márquez MDM, Barragán Martín AB, et al. Moral sensitivity, empathy and prosocial behavior: implications for humanization of nursing care. Int J Environ Res Public Health. 2020;17(23):8914.
7. Too A, Gatien C, Cormier S. Treatment satisfaction mediates the association between perceived physician empathy and psychological distress in a community sample of individuals with chronic pain. Patient Educ Couns. 2021;104(5):1213–21.
8. Paulus CM, Meinken S. The effectiveness of empathy training in health care: a meta-analysis of training content and methods. Int J Med Educ. 2022;13:1.
9. Interprofessional Education Collaborative. IPEC core competencies for interprofessional collaborative practice: version 3. Washington, DC: Interprofessional Education Collaborative; 2023.
10. Frank JR, Snell L, Sherbino J, Boucher A, CanMEDS. 2015. Physician competency framework series I. 2015.
11. Díaz-Narváez VP, Sandoval MA, Martínez AA, Monterroza LG, Reyes FR, Quiro LW, et al. Resilience and empathy in health science students. Eur J Educ Psychol. 2025;18(1):5.
12. Tei S, Becker C, Kawada R, Fujino J, Jankowski KF, Sugihara G, et al. Can we predict burnout severity from empathy-related brain activity? Transl Psychiatry. 2014;4(6):e393.
13. Cooke GP, Doust JA, Steele MC. A survey of resilience, burnout, and tolerance of uncertainty in Australian general practice registrars. BMC Med Educ. 2013;13(1):2.
14. Wang L, Huang S, Feng Z, Lin Y, Zhang Y. Chain mediation model of consultation empathy, resilience and resignation coping on depression: a cross-sectional study among patients with COVID-19 in China. BMJ Open. 2023;13(11):e079050.
15. Waddimba AC, Bennett MM, Fresnedo M, Ledbetter TG, Warren AM. Resilience. Well-being, and empathy among private practice physicians and advanced practice providers in Texas: a structural equation model study. Mayo Clinic Proceedings: Innovations, Quality & Outcomes. 2021;5(5):928–45.
16. Xing L, Deng SW, Ho GW. From empathy to resilience: the mediating role of emotional intelligence. Psychol Rep. 2023;13(2):641–65.
17. Wu W, Ma X, Liu Y, Qi Q, Guo Z, Li S, et al. Empathy alleviates the learning burnout of medical college students through enhancing resilience. BMC Med Educ. 2022;22(1):481.
18. Sang N, Zhu ZZ, Wu L, Shi PL, Wang LW, Kan HY, et al. The mediating effect of psychological resilience on empathy and professional identity of Chinese nursing students: a structural equation model analysis. J Prof Nurs. 2022;43:53–60.
19. Acosta-Martínez AA, Sandoval MA, Monterroza LG, Reyes-Reyes F, Reyes-Reyes A, Vilca LW, et al. Resilience as a modulating factor of empathy in medical students. Medicina Clínica y Social. 2024;8(2):207–12.
20. Rafaqat W, Sami A, Ibrahim MT, Ibad H, Awais S, Memon A, et al. Impact of perfectionism and resilience on empathy in medical students: a cross-sectional study. J Patient Experience. 2022;9:23743735221106603.

21. Maltby J, Day L, Hall S. Refining trait resilience: identifying engineering, ecological, and adaptive facets from extant measures of resilience. PLoS ONE. 2015;10(7):e0131826.
22. Decety J. Empathy in medicine: what it is, and how much we really need it. Am J Med. 2020;133(5):561–6.
23. Blanco Canseco JM, Valcárcel Sierra C, Guerra Jiménez MDC, Martín Martín J, Sastre Gómez R, Soler M, et al. Clinical empathy among family and community medicine residents and tutors. The view of physicians and patients. Aten Primaria. 2020;52(3):185–92.
24. San-Martín M, Delgado-Bolton R, Vivanco L. Role of a semiotics-based curriculum in empathy enhancement: a longitudinal study in three Dominican medical schools. Front Psychol. 2017;8:2018.
25. Jackson PL, Meltzoff AN, Decety J. How do we perceive the pain of others? A window into the neural processes involved in empathy. Neuroimage. 2005;24:771–9.
26. Scotland E. Exploratory investigations of empathy. In: Berkowitz L, editor. Advances in experimental social psychology. New York: Academic; 1969. p. 272.
27. Fernández-Pinto I, López-Pérez B, Márquez M. Empatía: Medidas, teorías y aplicaciones En revisión. Psicol. 2008;24(2):284–98.
28. Ulloque MJ, Villalba S, Varela de Villalba T, Fantini A, Quinteros S. Díaz-Narváez V. Empathy in medical students of Córdoba, Argentina. Arch Argent Pediatr. 2019;117(2):81–6.
29. Hojat M, Maio V, Pohl CA, Gonella JS. Clinical empathy: definition, measurement, correlates, group differences, erosion, enhancement, and healthcare outcomes. Discover Health Syst. 2013;2:8.
30. Eronen MI, Bringmann LF. The theory crisis in psychology: how to move forward. Perspect Psychol Sci. 2021;16(4):779–88.
31. Kline R. Principles and practice of structural equation modeling. 5th ed. New York: The Guilford Press; 2023.
32. Rhemtulla M, Brosseau-Liard P, Savalei V. When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. Psychol Methods. 2012;17(3):354–73.
33. Whittaker T, Schumacker R. A beginner's guide to structural equation modeling. 5th ed. New York: Routledge; 2022.
34. Muñiz J. Introducción a La psicometría: Teoría clásica y TRI. Madrid: Pirámide; 2018.
35. Ghafourifard M, Zamanzadeh V, Valizadeh L, Rahmani A. Compassionate nursing care model: results from a grounded theory study. Nurs Ethics. 2022;29(3):621–35.
36. Parveen K, Hussain K, Afzal M, Gilani SA. Determining the association of high-commitment human resource practices with nurses' compassionate care behaviour: a cross-sectional investigation. J Nurs Manag. 2020;28(1):120–9.
37. Calzadilla-Núñez A, Díaz-Narváez VP, Dávila-Pontón Y, Aguilera-Muñoz J, Fortich-Mesa N, Aparicio-Marenco D, et al. Erosion of empathy during medical training by gender. A cross-sectional study. Arch Argent Pediatr. 2017;115(6):556–61.
38. Al-Omari H, Aljawarneh YM, Al-Rawashdeh S. The relationship between resilience and cognitive load among college level students: a cross-sectional study. Crit Public Health. 2025;35(1):2504074.
39. Galy E, Cariou M, Mélan C. What is the relationship between mental workload factors and cognitive load types? Int J Psychophysiol. 2012;83(3):269–75.
40. Sweller J. Element interactivity and intrinsic, extraneous, and germane cognitive load. Educ Psychol Rev. 2010;22:123–38.
41. Badarin AA, Shishkin SL, Lyush D, Skvortsova E, Pechenkova EV, Zinchenko YP. Brain compensatory mechanisms during the prolonged cognitive task: fNIRS and Eye-Tracking study. IEEE Trans Cogn Dev Syst. 2024. https://doi.org/10.1109/TCDS.2024.3453590].
42. Crespi BJ. Cognitive trade-offs and the costs of resilience. Behav Brain Sci. 2015. https://doi.org/10.1017/S0140525X14001502.
43. Howick J, Dudko M, Feng SN, Ahmed AA, Alluri N, Nockels K, et al. Why might medical student empathy change throughout medical school? A systematic review and thematic synthesis of qualitative studies. BMC Med Educ. 2023;23(1):270.
44. Gamble RS, Henry JD, Vanman EJ. Empathy moderates the relationship between cognitive load and prosocial behaviour. Sci Rep. 2023;13(1):824.
45. Shapiro J. The paradox of teaching empathy in medical education. Acad Med. 2011;86(11):1457.
46. Brown ME, MacLellan A, Laughey W, Omer U, Himmi G, LeBon T, et al. Can stoic training develop medical student empathy and resilience? A mixed-methods study. BMC Med Educ. 2022;22(1):340.
47. Stepien KA, Baernstein A. Educating for empathy: a review. J Gen Intern Med. 2006;21:524–30.
48. Gilligan C, Powell M, Lynagh MC, Ward BM, Lonsdale C, Harvey P et al. Interventions for improving medical students' interpersonal communication in medical consultations. Cochrane Database Syst Rev. 2021(2):CD012759.
49. Zhang X, Pang H, Duan Z. Educational efficacy of medical humanities in empathy of medical students and healthcare professionals: a systematic review and meta-analysis. BMC Med Educ. 2023;23(1):925.
50. Hojat M, Vergare MJ, Maxwell K, Brainard G, Herrine S, Isenberg GA, et al. Enhancing and sustaining empathy in medical students. Med Teach. 2013;35(12):996–1001.
51. Chrisman-Khawam LM, Manzi JA. Empathy in medicine cultivating an empathetic professional identity in osteopathic medical students through service learning: a qualitative analysis of reflective essays. J Osteopath Med. 2020;120(4):263–72.
52. Lumish R, Simpkins S, Black J, Whittaker CF. Fostering empathy and self-efficacy in pharmacy students through service learning. Curr Pharm Teach Learn. 2022;14(4):536–46.
53. Díaz-Narváez V, Dávila Pontón Y, Marín Dávila M, Carbone Paz B, Reyes-Reyes A, Calzadilla-Núñez A. Empatía Con El Paciente En médicos especialistas Que Trabajan En Un hospital de Cuenca (Ecuador). Rev Cienc Salud. 2024;22(2):1–14.
54. Caldera Montes JF, Aceves Lupercio BI, Reynoso González ÓU. Resiliencia En estudiantes universitarios. Un estudio comparado Entre Carreras. Psicogente. 2016;19(36):227–39.
55. Rodríguez Ugalde E, Ortiz Solano A. Factores relacionados Con La respuesta resiliente Del estudiantado universitario. Revista Iberoamericana ConCiencia. 2023;8(Especial):36–48.
56. Barrales Díaz CR. Resiliencia En estudiantes universitarios En contexto de pandemia y Confinamiento Por COVID 19 En América latina, El caribe e Hispanoamérica. PsicoInnova. 2022;6(2):16–24.
57. Huerta-González S, Meléndez-Chávez S, Barrios-Melchor A, De las Salas R, Reyes-Reyes A, Díaz-Narváez V. Caracterización psicométrica y distribución empática Entre Las áreas académicas En estudiantes de Enfermería. Rev Investig Innov Cienc Salud. 2024;6(2):94–112.
58. Díaz-Narváez VP, Calzadilla-Núñez A, Reyes-Reyes A, Lastre Amell G, Castellón-Montenegro H, Andrade Valles I, et al. Empathy, psychometrics, cut-off points in nursing students from Latin America. Int Nurs Rev. 2023;70(2):185–93.
59. Sánchez Castro YS, Guerrero Quiroz ES. Nivel de empatía En estudiantes de Enfermería En Una Universidad privada de Chiclayo, 2022. ACC CIETNA: Revista de la Escuela de Enfermería. 2024;11(1):e1072.
60. Díaz-Narváez VP, Silva-Vetri MG, Stocklin B, González-Díaz E, Calzadilla-Núñez A, Torres-Martínez P, et al. Empathy levels among dental students and professors from a dental school in the Dominican Republic. Rev Fac Med. 2022;70(2):e90850.
61. Díaz-Narváez VP, Silva-Vetri MG, Calzadilla-Núñez A, García ALL, Lopez ALP, Reyes-Reyes A. Empathy in professors and students of a school of dentistry in the Caribbean. Pesqui Bras Odontopediatr Clín Integr. 2022;22:e200240.
62. Díaz-Narváez VP, Huberman-Casas J, Nakouzi-Momares JÁ, Alarcón-Ureta C, Jaramillo-Cavieres PA, Espinoza-Retamal M, et al. Levels of empathy in students and professors with patients in a faculty of dentistry. Behav Sci. 2024;14(9):817.
63. González-Díaz ES, Silva-Vetri MG, Díaz-Calzadilla P, Calzadilla-Núñez A, Reyes-Reyes A, Díaz-Narváez VP. Decline in empathy levels and sex differences in medical students from the Caribbean. Rev Fac Med. 2021;69(4):e86227.
64. Díaz-Narváez VP, Calzadilla-Núñez A, Reyes-Reyes A, Silva-Vetri MG, Torres-Martínez P, Eugenia González-Díaz E, et al. Psychometry and Cut-off points of the Jefferson scale of empathy in medical students in central America and the Caribbean. PR Health Sci J. 2022;41(1):22–8.
65. Alonso-Palacio LM, Ríos-García AL, Cervantes M, Arcila-Calderón C, Alonso-Cabrera J, Brown-Ríos M, et al. Empatía En estudiantes de medicina de La Universidad Del norte, Colombia. Comparación de Dos grupos (2012 y 2015). Rev Fac Med. 2020;68(2):229–36.
66. Vidal Madera Anaya M, Tirado Amador LR, González Martínez F. Factores relacionados Con La empatía En estudiantes de medicina de La Universidad de Cartagena. Rev Clin Med Fam. 2015;8(3):185–92.
67. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. Struct Equ Modeling. 2007;14(3):464–504.
68. Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. Front Psychol. 2013;4:863.

69. Findyartini A, Greviana N, Muhammad Putera A, Larope Sutanto R, Yora Saki V, Felaza E. The relationships between resilience and student personal factors in an undergraduate medical program. BMC Med Educ. 2021;21(1):113.
70. Sewell JL, Maggio LA, Ten Cate O, van Gog T, Young JQ, O'Sullivan PS. Cognitive load theory for training health professionals in the workplace: A BEME review of studies among diverse professions: BEME guide 53. Med Teach. 2019;41(3):256–70.

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