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The impact of resilience training for supervisors on the development of resilience in physiotherapy students during internships in clinical practice: a randomized controlled questionnaire study

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Abstract

Background

Physiotherapy is among the top ten professions facing a skilled labour shortage in Germany. Around 33% of students drop out annually. One factor is low resilience, especially during internships when students face patient-related stressors. Low resilience may hinder stress management and coping with setbacks. The aim of the study was to examine whether supervision by resilience-trained internship supervisors affects students' resilience differently to untrained supervision, and whether students with low initial resilience benefit more than students with low resilience.

Methods

Four internship supervisors received training on resilience and how to promote it. Resilience was assessed using a digital questionnaire, including socio-demographic data, the Conner-Davidson Resilience Scale-10 (CD-RISC-10) and the Resilience Scale for Adults (RSA). The first measurement (t_0) occurred at the end of the internship supervisors' training, and the second (t_1) two months later. Students supervised by trained internship supervisors formed the intervention group, those with untrained internship supervisors formed the control group. Data was analysed using JASP to identify significant changes and correlations.

Results

The intervention group showed a statistically significant improvement from t_0-t_1 in CD-RISC-10 scores (p = 0.009; d = 0.585). Group comparisons revealed that the intervention group improved significantly in both CD-RISC-10 (p = 0.004) and RSA (p = 0.038), whereas the control group did not show significant improvements. Additionally, a strong negative correlation was found between initial resilience levels and improvement in the intervention group (CD-RISC-10: r_p= -0.686, p < 0.001; RSA: r_p= -0.592, p = 0.002), indicating that those with lower initial resilience benefited more.

Conclusion

The results of the study therefore offer initial insights into the resilience of the students and the possible effect of training the teachers. This study introduces the development of a resilience concept that could be developed with the help of additional research.

Trial registration:

The study was registered in the Open Science Framework on 17.09.2023 (DOI 10.17605/OSF.IO/3TMYW). The study was also retrospectively registered in the German Clinical Trials Register (DRKS; DRKS00041437) on 02 September 2026.

Introduction

The high demand for physiotherapists in Germany is evident, which assigns physiotherapy a bottleneck indicator of 2.7(1). This metric reflects factors such as job vacancy duration, jobseeker-to-job ratio, and unemployment rates. The issue has also been recognised internationally. For instance, earlier forecasts in the United States pointed to potential shortages in the workforce. Estimates from the Health Resources and Services Administration suggest that, by 2036, demand for physical therapists could exceed the available workforce by around 6,500 full-time equivalents, equating to a 2% gap (2).

To address this problem, new physiotherapists are trained. Although trainee numbers have slightly increased only 67% of those who began training completed it (3). While financial barriers were once considered a primary cause for dropouts in physiotherapy training in Germany, the rise in tuition-free schools has not reduced those. Like other degrees as nursing, students may face psychological and physical stress (4), suggesting a broader issue across healthcare professions.

Euler identifies two strategies to reduce dropout rates: structural reform and trainee empowerment (5). The current German curriculum, based on the 1994 Training and Examination Regulations for Physiotherapists (PhysTh-APrV) and Law on professions in physiotherapy (Masseur and Physiotherapist Act) mandates 2,900 hours of theoretical learning and 1,600 hours of practical training. However, only governmental bodies can alter these structures, making trainee support a more immediate solution.

Students experience varying levels of stress resilience, especially during their first patient-facing internships. Some struggle with the level of patient suffering and crises, while others grow from the experience (6, 7). Holick suggests that individual resilience plays a key role in managing stress and setbacks (8).

The concept of resilience is still relatively new but has become very widespread in recent years. It can be classified under health promotion and prevention and refers to the maintenance or restoration of mental health. It is assumed that various protective and resilience factors enable an individual to adapt to increasing stress, and that a lack of adaptation can lead to stress, burnout, or mental and physical illness (9). Several of these factors and their evidence have been described in a systematic review (10). These factors are presented in the table below (Table 1).

Table 1
Evidence Level of resilience factors

Level of evidence	Factors
1a	Active coping, e.g.: problem solving, self-efficacy, optimism, social support, cognitive flexibility, religiosity/spirituality
1b	Positive emotions, hardiness (resilience), self-esteem
1c	Meaning in life, sense of coherence
2a	Belief in control, coping flexibility
2b	Hope
2c	Humour
3	Selflessness

Table 1 clearly shows that some factors, such as social support and active coping, have good evidence. The studies thus show that well-developed factors have a positive effect on resilience. For example, self-esteem involves the ability to recognize one's personal strengths and to acknowledge past achievements. Individuals with higher self-esteem tend to draw on these internal resources when facing challenges, which enhances their confidence in coping effectively and supports adaptive responses to stress. Positive emotions mean, for example, accepting life as it is.

In addition to the resilience and protective factors mentioned above, resilience is sometimes also divided according to resources. A distinction is made between individual, structural and social resources. Resilience and protective factors, as described above, are typical examples of the psychological resources, as these relate to individual resources. In addition to psychological resources, there are also structural resources that can contribute to well-developed resilience. Structural resources include, for example, contextual prerequisites for resilient behaviour. The third resource for resilience is social resources. These can include family or friendship support (11). Resources and factors are often used to measure resilience with the help of questionnaires (9). The WHO's Health 2020 report calls for strengthening resilience and developing a supportive environment for health and well-being as part of healing, rehabilitation, prevention, and health promotion measures (12). Interventions for resilience target different resources and skills, depending on the underlying concept of resilience. There are a variety of measures for different target groups, which also differ in terms of how they are presented.

A research project unique in Germany was conducted between 2017 and 2020 and expanded during the coronavirus pandemic in 2021. As part of the joint project" Resilienz und Studienerfolg in MINT-Fächern" (ReSt@MINT), various studies examined how universities can support the resilience of their students (13). This project assumes that resilience potential can be promoted by strengthening resilience resources. Students who use structural, social, and psychological resources are considered resilient

(11). The students in this study have similar living conditions to physiotherapy trainees, so the results may be applicable to physiotherapy. However, this has not yet occurred. Nevertheless, there are already resilience intervention studies in other areas of the healthcare system.

A study demonstrated improved resilience among midwives and nurses(14). In this pilot study, training focused on strengthening mindfulness was conducted. The mindfulness training was intended to strengthen health and a sense of coherence while reducing depression, stress, and anxiety. This should lead to an improvement in resilience. After the intervention, the test subjects showed a significant improvement in terms of health and sense of coherence. An effect on resilience could not yet be proven in this study. Further studies conducted with intensive care nurses also showed that resilience training is possible and feasible. However, further detailed RCTs are needed to prove the effectiveness of the program (15). Additional studies in the field of nursing and nursing education suggest that resilience can be promoted through resilience training (16–23). The forms of intervention vary from mindfulness-based training, cognitive behavioural therapy, and problem-solving therapy to stress management. There is significantly less research in the field of physiotherapy training. An RCT examined the effect of an eight-hour resilience program on students' resilience

(18). In this study, the intervention group showed a significant improvement in resilience, as measured by the CD-RISC. A cross-sectional study from Baden-Württemberg in 2020 used the Resilience Scale 13 to measure the resilience of physiotherapy trainees at three physiotherapy schools in their first and fifth semesters. It was found that resilience among physiotherapy trainees is low and that ‘it would be important to strengthen the resilience of prospective physiotherapists, especially in their first semester (24). No further studies in the field of resilience and physiotherapy have been published to date.

To date, the empirical evidence for resilience interventions remains unclear (25) and there is an ‘urgent need for evidence-based resilience research (26).

The aim of this study was to investigate how resilience changes in physiotherapy students during and after internships and the extent to which internship supervisors can influence this development. It also explores whether students with initially low resilience benefit differently from interventions than those with high resilience.

Methode

Study design:

The study was designed as a randomized controlled trial with two parallel groups.

To ensure methodological transparency, the study reporting follows the CONSORT guidelines (27). Ethical approval was granted by the Ethics Committee of Döpfer University of Applied Sciences (Application No. BEth_61_23, July 14, 2023).

Blinding and group allocation:

Group allocation was randomized based on which internship supervisors were assigned to supervise each practice facility, aligning with cluster randomization principles (28, 29). The clusters were defined by the clinics or clinical practices where students completed their internships. The two groups were: an intervention group supervised by internship supervisors trained in resilience, and a control group supervised by untrained internship supervisors.

The study was single-blind: students are unaware of their internship supervisors' training status. However, neither students, internship supervisors, nor the researcher can trace resilience scores back to individuals, ensuring appropriate pseudonymisation by using a student generated five-character code based on personal but non-identifiable traits (30).

Data collection

Outcomes were obtained via a quantitative questionnaire, chosen for its efficiency in collecting data from many participants (31). To address the risk of incomplete responses, mandatory fields were implemented. As the study aimed to explore trends in resilience development, it uses a descriptive research design, appropriate given the lack of prior findings in this area (32).

The online questionnaire was created using SoSci Survey. It was chosen for its efficiency and compatibility with students' everyday use of digital devices. Data transfer was encrypted, and evaluation data was stored securely on a password-protected USB stick.

Students were recruited during school hours via personal contact and the learning platform. To reduce non-response, multiple reminders were issued. Participation required a unique link and password, and students had to give informed consent before proceeding. The survey was anonymous, voluntary, and could be exited at any time. Respondents could not return to previous pages, and there was no time limit.

The questionnaire began with an introduction covering project details, consent, data protection, and code creation. Demographic data were collected in both survey rounds, including age, gender, living situation, marital status, education level, and number of internships. The second round added questions on internship participation between mid-September and November 2023, and the number of supervision sessions per internship supervisor.

In addition to sociodemographic data, the questionnaire comprised items from two previously published and validated resilience measures: the Resilience Scale for Adults (RSA) (33) and the Connor-Davidson Resilience Scale (CD-RISC-10)(34).

The RSA, developed in Norway in 2003, consists of thirty-three items rated on bipolar 7-point visual analogy scales. Only the extremes are assigned verbal scale labels (35). The RSA uniquely measures resilience across three domains: personal, family, and social. These are divided into six subscales: Self-Perception, Future Planning, Social Competence, Family Cohesion, Social Resources, and

Structuredness. Each subscale produces an individual score, and some items are reverse coded to reduce response bias (36). Higher scores indicate stronger protective factors.

A German version of the RSA has been tested for validity, internal consistency, (α = 0.54–0.90) and factorial structure with good psychometric properties (37).

The second resilience instrument used in this study is the CD-RISC-10, a shortened version of the original 25-item scale to 10 items. It measures individuals' ability to cope with internal and external stressors. Unlike the RSA, which assesses protective factors, the CD-RISC-10 focuses on stress response. Items are rated on a 5-point Likert scale from 0 ("not true at all") to 4 ("almost always true") (38).

Due to its brevity and ease of use, the CD-RISC-10 is widely applied. Sarubin et al. (2015) validated the German version, confirming its reliability ($p < .001$) and good convergent validity ($rtc = .60$ $p < .001$) (39).

Given the lack of a universally accepted definition of resilience, both instruments were selected to capture different dimensions of the construct. The RSA measures resilience based on multifactorial structures, namely personal, family, and social protective factors, whereas the CD-RISC-10 measures the effective handling of internal and external stressors and the associated high level of resilience. In contrast to the RSA, the CD-RISC-10 does not measure the presence of protective factors, but rather the direct handling of stressors.

Pretest

The pretesting of the questionnaire took place over a total of three stages. The first pretest of the online questionnaire was conducted in a face-to-face situation with a fellow student from the master's program in Medical Education. A second pretest was conducted in which trainees from the exam course at the vocational school for physiotherapy in Hamburg were asked to complete the questionnaire. The pretest was conducted online using the SoSci Survey tool, and participants were asked to leave their feedback in the online questionnaire. Based on this feedback, further adjustments were made to the questionnaire.

The third pretest was conducted by individuals who had already obtained a scientific degree. The comments of these participants were recorded and incorporated into the adaptation of the questionnaire. At the same time, a technical pretest was conducted.

Intervention

The intervention involved training internship supervisors using the "train-the-trainer" method. The training was developed and delivered by a final-semester Bachelor student in a Therapeutic Science degree and former physiotherapy trainee. Drawing on her own training experience, she designed two virtual sessions in consultation with the study authors.

Four internship supervisors participated, who differed in age, gender, and educational experience in years, ensuring a heterogeneous intervention group (Table 2).

Table 2
demographic data of the supervisors

Age (mean (SD))	**characteristics**
	36,5 (8.7)
Gender (n (%))	
Female	75
Male	25
Non-binary	0
Educational experience in years (mean (SD))	4,75 (3,86)

All signed a consent form, agreeing to apply the training content and refrain from sharing it with colleagues.

The sessions were held via Microsoft Teams at the beginning of September 2023, each lasting two hours. A PowerPoint presentation guided the training and was shared with participants afterwards. The first session introduced resilience concepts, definitions, research stages, and the operationalisation of protective, risk, and resilience factors, following Hofmann et al. (2021). The second session focused on resilience in students, practical interventions, and exercises for internship supervision. It also included time for experience sharing and discussion of potential challenges.

In the second half of August 2023, all physiotherapy students at a vocational school for physiotherapy were asked to complete the questionnaire for the initial measurement (t_0) on the topic of resilience. The data collection for the baseline measurement (t_1) in the second half of November 2023. All students who completed an internship during the relevant period were asked to take part in this test.

Sample size calculation:

Based on a priori power analysis, the required sample size was determined to be n = 47. With a population of eighty-one eligible students, this sample size yields a 9% margin of error at a 95% confidence level (40).

Study population:

The inclusion process is illustrated in Fig. 1. All students at the vocational school were eligible to participate in the study if they were doing an internship during the study period. The exception was the exam course, as this was already part of the pre-test group. Exclusion criteria included incomplete

questionnaires, unclear group assignment, missing pre/post measurements, and no internship during the study period. As participation was voluntary, the sample is non-probabilistic and subject to self-selection bias (41).

Before analysis, the data from pre- and post-questionnaires were merged using the individual code to match responses. Group assignment (intervention or control) was based on the supervising internship supervisor. Incomplete datasets, missing CD-RISC-10 or RSA responses, or missing internship supervisor information, were excluded. Outliers were retained, as they are relevant to the study.

Initial data processing was managed by the online survey tool, which assigned numerical values and applied reverse coding where needed. Total scores for CD-RISC-10 and RSA were calculated in Excel using formula functions to minimize human error. The final datasets were saved as CSV files for statistical analysis.

Data analysis:

Data analysis was conducted using JASP (Jeffrey's Amazing Statistics Program, JASP-Team, 2023). Both descriptive and inferential statistical methods were applied. Since the outliers in the data are particularly important for the study, they are included in the statistical data. The individual data sets have not been weighted. Within the scope of this work, the individual rating scales were ordinal scales, and the results were evaluated accordingly. If the point values of the individual rating scales are added together, as is the case with the sum value of the RSA and the CD-RISC-10, this value can clearly be regarded as interval scaled, meaning that values for metric scale levels can also be calculated (42). In addition to visual inspection, the Kolmogorov-Smirnov test was used to check for normal distribution (40). Compared to the Shapiro-Wilk test, this test is more suitable for small sample sizes (43). As is customary in most studies, the significance level was set at 5%, which ensures that if $p < 0.05$, significant values are present. If $p < 0.01$, the results are highly significant, and if $p < 0.001$, the values are extremely significant (38). Schäfer & Schöttker-Königer (2015) add: 'In order to estimate the strength of a therapeutic effect independently of the measuring instrument used, a standardised measure can be calculated: Cohen's d. (40). This value can be analysed as follows: if $d \geq 0.2$, a smaller effect of the intervention is assumed. If $d \geq 0.5$, the effect is moderate, and if $d \geq 0.8$, the intervention is assumed to have a large effect. The effect size r is calculated for the difference between two medians. This can be evaluated in the same way as Cohen's d (42, 43). The t-test used depended on whether the data were normally distributed and had the same variance. For unpaired samples, either the t-test for two independent groups or the Mann-Whitney U test was performed. In contrast, the change over time within a group was calculated using a paired samples t-test (31). If the data are not normally distributed, the Wilcoxon test is used instead of the t-test. The Pearson correlation was used to calculate the correlation, as this study assumes that the sum values of rating scales are interval scaled (46). If there was no normal distribution, the Spearman rank correlation was used. According to Portney & Watkins (2009), values between 0 and 0.25 indicate a weak correlation, values between 0.25 and 0.5 indicate a moderate

correlation, values between 0.5 and 0.75 indicate a strong correlation, and values above 0.75 indicate a strong correlation in therapy research (45).

Results

Sample Characteristics and Group Allocation

At t_0 131 students were enrolled, twenty of whom were in the examination course.

Not all initial participants completed the final measurement. Twelve responses were excluded due to missing internship participation, eleven due to missing codes at t_0 or t_1, and two due to unclear group assignment. The final sample consisted of forty-seven valid cases: twenty-four in the intervention group and twenty-three in the control group.

Table 3
socio-demographic characteristics and the resilience measurement

	Control (n = 23)	**Intervention (n = 24)**
socio demographic characteristics		
Age (mean (SD))	22 (1.6)	23 (2.7)
Gender (n (%))		
Female	78%	71%
Male	18%	29%
Non-binary	4%	0%
Living situation (n (%))		
Parental home	35%	33%
Alone	35%	21%
With partner	26%	8%
Shared flat	4%	38%
Living situation (n (%))		
single	92%	100%
married	4%	0%
other marital status	4%	0%
Education level (n (%))		
Master’s degree	0%	0%
Bachelor's degree	0%	8%
Completed vocational training	0%	0%
A-levels	92%	75%
entrance qualification for universities of applied sciences	4%	13%
intermediate school leaving certificate	4%	4%
Completed internships (n (%))		
0	39%	21%
1	4%	29%
2	31%	38%

	Control (n = 23)	Intervention (n = 24)
socio demographic characteristics		
3	26%	22%
Resilience measurement		
CD-RISC-10 t_0 (Mean (SD))	36.609 (7.542)	34.917 (7.089)
CD-RISC 10 t_1(Mean (SD))	36 (6.252)	37.417 (5.191)
RSA t_0 (Mean (SD))	187 (25.817)	167.33 (27.282)
RSA t_1 (Mean (SD))	184 (27.004)	170.50 (22.212)

Table 3 presents the socio-demographic characteristics and the resilience measurement of participants in the control (*n* = 23) and intervention (*n* = 24) groups. Students in the intervention group, supervised by trained internship supervisors, showed an average increase of 2.5 points on the CD-RISC-10. In contrast, the control group experienced an average decrease of 0.69 points. On the RSA, the intervention group showed no average change, while the control group had a median decrease of three points. Both instruments indicate that resilience levels in the intervention group remained stable or improved, whereas the control group showed a decline.

The development of resilience over time in both groups is presented in Table 4.

Table 4
development of resilience measurement with CD-RISC-10 in time

CD-RISC-10 t_0 and t_1	p-Value	Effect size
control	0.139	*r* = 0.381
intervention	0.009	*d* = 0.585
Difference	0.004	*r* = 0.496

There is no significant difference in the development of the medians from t_0 to t_1 in the control group. In the intervention group, the mean values increase highly significantly by an average of 2.5 points (*SD* = 4.27). Cohen's d is 0.585, which indicates that the effect is in the medium range.

The Mann-Whitney U-test shows that the median improvement in the CD-RISC-10 in the intervention group of 2.5 points is higher than in the control group with a median of -2 points, (p = 0.004). The effect size *r* is 0.49 and is therefore slightly below 0.5, which indicates that there is only a slight effect size.

The same tests were also calculated for the RSA (Table 5).

Table 5
development of resilience measurement with RSA in time

RSA t_0 and t_1	***p***	**Effect size**
control	0.053	$r = 0.464$
intervention	0.243	$d = 0.245$
Difference	0.038	$r = 0.355$

Both groups showed no significant time-dependant difference in RSA-scores ($p = 0.053$; $p = 0.243$), with the control group slightly missing statistical significance.

In addition to the change between the measurement points t_0 and t_1, the development of the total score in the RSA was also compared in both groups. The Mann-Whitney U test shows that the median did not change in the RSA in the intervention group, but it is significantly higher than in the control group, which saw a median decrease of 4 points ($p = 0.038$). The effect size is 0.355, which indicates that there is a slight effect size.

In addition, it was evaluated whether there was a correlation between the input or output values of the CD-RISC-10 and the RSA. In other words, it was evaluated whether students who had fewer points in the CD-RISC-10 also had fewer points in the RSA. As the RSA of the initial measurement is not normally distributed, the Pearson test was used to check whether there is a positive correlation between t0 in the CD-RISC-10 and the RSA or not. For t1-scores, the Spearman test was used. The results can be seen in the Table 6.

Table 6
Correlation between RSA & CD-RISC-10

correlation between		**Pearsons (r_p)**	***p***
CD-RISC-10 t_0	RSA total t_0	0.651	≤ .001
correlation between		**Spearman (r_s)**	**p**
CD-RISC-10 t_1	RSA total t_1	0.569	≤ .001

The measured values of the variables CD-RISC-10 t_0 and RSA total t_0, as well as for the second measurement point show strong, highly significant, positive correlations with $r_p = 0.651$ and $r_s = 0.569$ ($p \leq 0.001$), respectively, as expected.

The results of the relationship between the initial expression of resilience and the effect of the intervention can be seen in Table 7.

Table 7
correlation initial resilience and resilience development

Group	correlation between		Spearman r_s	p
control	difference t_1-t_0 CD-RISC-10	CD-RISC-10 t_0	-0.379	0.037
	difference t_1-t_0 RSA total	RSA total t_0	-0.051	0.408
	correlation between		**Pearson r_p**	**p**
intervention	difference t_1-t_0 CD-RISC-10	CD-RISC-10 t_0	-0.686	< .001
	difference t_1-t_0 RSA total	RSA total t_0	-0.592	0.002

In the intervention group, the negative correlation between the difference of the CD-RISC-10 and the input value of this test is strong (r_p= -0.686) and highly significant with p = ≤ 0.001. The same applies to the negative correlation between the difference of the RSA and its input values with r_p= -0.592 (p = 0.002). Therefore, there is a negative correlation between the starting number of points on the CD-RISC-10 or the RSA in relation to the number of points gained at the end of the intervention. Students who already started with a high number of points in the measurement instruments gain fewer points in these measurement instruments while the intervention.

It was checked whether there is a positive correlation within the group resilience development of the CD-RISC-10 and the RSA. The results are shown in Table 8.

Table 8
correlation between the development of the two measurement items.

Group	correlation between		Spearman r_s	p
control	difference t_1-t_0 CD-RISC-10	difference t_1-t_0 RSA	0.190	0.192
	correlation between		**Pearson r_p**	**p**
intervention	difference t_1-t_0 CD-RISC-10	difference t_1-t_0 RSA	0.380	0.067

It can be concluded from the values that there is no significant correlation between the differences between the CD-RISC-10 and the RSA in the control group, nor in the intervention group.

Discussion

Summary of Findings

The results clearly show that internship supervisor training in resilience and resilience promotion had a positive impact on physiotherapy students' resilience after their internship. Students who were

supervised by trained supervisors demonstrated a significant improvement in resilience compared to those in the control group. This was evident in both measurement instruments (CD-RISC-10 and RSA), with the intervention group showing positive changes while the control group experienced a decline.

This confirms that there is a measurable difference in resilience development between students supervised by trained supervisors and those without such supervision.

Additionally, the results indicate that within the intervention group, students with lower initial resilience levels benefited more from the intervention than those who started with higher resilience scores.

Development of resilience

Students in the intervention group were supervised multiple times by internship supervisors trained in resilience promotion. Internship supervisors encouraged the use of resilience resources during internships, following established guidelines (11). The intervention group showed a greater improvement on the CD-RISC-10 than on the RSA, reflecting the different focuses of the instruments: CD-RISC-10 measures stress management (38), while RSA assesses protective factors (37).

These instruments belong to distinct categories of resilience measurement: CD-RISC-10 captures responses to stressors, while RSA evaluates underlying psychological resources

(48). This explains why trained internship supervisors had more influence on CD-RISC-10 scores. RSA scores remained stable in the intervention group but declined in the control group. Although both instruments showed a weak positive correlation between pre- and post-measurements, the correlation was not statistically significant. Subscale analysis revealed that “family support” showed the greatest variation across both groups, indicating differing levels of external support. Internship supervisors could not influence this directly, but RSA results may help identify students lacking supportive relationships. Wustmann emphasized the importance of such relationships for resilience development (49). The “self-perception” subscale, linked to self-efficacy, showed improvement in both groups, due to feedback and reflection during internships (50). Since all internship supervisors are trained in pedagogical feedback, this effect is not exclusive to the intervention. Despite measuring resilience differently, CD-RISC-10 and RSA scores were positively correlated at baseline, consistent with previous findings (51). This suggests that lacking protective factors may impair stress management and adaptability (9).

In summary, trained internship supervisors positively influenced students’ resilience, particularly in handling stressors. The intervention group showed measurable improvement, supporting the effectiveness of the “train-the-trainer” approach. Comparable results were reported, although that study involved direct training of students(18). No other RCTs using this model are currently available for comparison.

It is important to note that not all students in the intervention group improved. Some showed decreased scores post-intervention, due to stronger external stressors or unexamined factors.

Correlation between the level of resilience and the effect of the intervention

The study shows that students with lower initial resilience benefited more from the intervention than those with higher baseline scores. Participants who began with higher resilience showed smaller gains on both the RSA and CD-RISC-10. This aligns with findings by Hofmann et al. (2020), who noted that students with lower resilience benefit more from interventions targeting self-confidence, self-efficacy, optimism, and internal locus of control-factors addressed in the internship supervisor training (11).

It has been observed that not all participants benefit from resilience interventions, with some even showing declines (25). They highlight the limited evidence base due to a lack of RCTs with pre- and post-measurements and follow-ups. This study addresses part of that gap by including entry and exit measurements, though no follow-up was conducted (25).

The only known resilience intervention study in physiotherapy did not differentiate which students benefited most, reflecting a common limitation in resilience research. While many studies report overall group effects, they rarely explore individual variation within intervention groups (18).

Limitations and strengths of the study

This study provides valuable insights into resilience development through internship supervisor training, yet several limitations must be considered. The questionnaire method represents the lowest level of evidence (52). Demographic differences between control and intervention groups, particularly in age and education, may limit comparability. The control group also showed higher baseline resilience scores on the CD-RISC-10 and RSA, which may affect generalizability. More balanced samples are recommended, although the diversity in this study may offer broader insights.

Randomization based on internship supervisor assignment may introduce selection bias (53), but it reflects real-world conditions and reduced performance bias (54), as supervisors were unaware of students' resilience levels. Untrained supervisors were also unaware of the study, minimizing behavioural changes.

Voluntary participation may have caused self-selection bias (55). Although representativeness is limited, voluntary and anonymous participation reduced response bias (56). Future studies could explore strategies to increase participation, though incentives raise ethical concerns.

Measurement bias is another limitation, as no gold standard for resilience assessment exists. Two validated German-language tools, the CD-RISC-10 and RSA, were used. While the RSA may not have been ideal for detecting intervention effects, it offered insights into protective factor distribution.

The short intervention period also limits conclusions, as resilience development typically requires more time. Longer follow-up (six to twelve months) would be valuable but was not feasible.

External influences such as clinical supervisors or peer interactions may have affected resilience development and cannot be fully controlled. Interviews could help identify influential internal and external factors. Students may also have independently engaged in resilience-building strategies, which qualitative methods could capture.

Relevance

While this study marks only the beginning of resilience research in physiotherapy education, it highlights the potential of faculty training to reduce dropout rates and address the shortage of skilled professionals. Further research is needed to refine and expand these findings.

This study shows that students with low initial resilience benefit most from support, emphasizing the importance of early identification and tailored interventions. Internship supervisor training can play a key role in this process. The better internship supervisors are trained in resilience, the more effectively they can support students.

These results offer a foundation for developing a resilience concept, which could be expanded through long-term studies, follow-ups, and qualitative methods such as interviews.

Future research should also explore other factors contributing to dropout rates, which remain high at around 33%. Interviews or questionnaires with dropouts could help identify underlying causes, though participation may be limited. Identifying students with low resilience early and offering targeted support could be another strategy. The RSA, which highlights individual protective factors, could guide such interventions.

Conclusions

The findings suggest that internship supervisor training had a positive impact on resilience development. Two months of post-intervention, students in the intervention group showed higher CD-RISC-10 scores and stable RSA scores, while the control group declined.

Abbreviations

CD-RISC-10..... Conner-Davidson-Resilience-Scale-10

CONSORT..... Consolidated Standards of Reporting Trials

JASP..... Jeffreys Amazing Statistic Programm

MINT.....Mathematik Informatik Naturwissenschaften Technik

(engl. STEM Science, Technology, Engineering, Mathematics)

RCT..... randomized controlled trials

r_p ..... Pearson correlation coefficient

r_s ..... Spearman correlation coefficient

RSA..... Resilience Scale for Adults

SD..... standard deviation

SRe..... systematic review

t_0 .....pre-measurement

t_1 ..... post-measurement

WHO World Health Organization

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and applicable institutional guidelines. Ethical approval was obtained from the Ethics Committee of Döpfer Hochschule (Application No. BEth_61_23) on 14 July 2023. Prior to participation, all participants were informed about the purpose and procedures of the study as well as the processing of their data. Participation was voluntary, and electronic informed consent was obtained from all students and internship supervisors before completion of the questionnaire. All collected data were anonymized prior to analysis.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests

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Author Contribution

C.B. wrote the main manuscript. M.P. and G.F. contributed to the development and revision of the manuscript. All authors reviewed, revised, and approved the final version of the manuscript.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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Figures

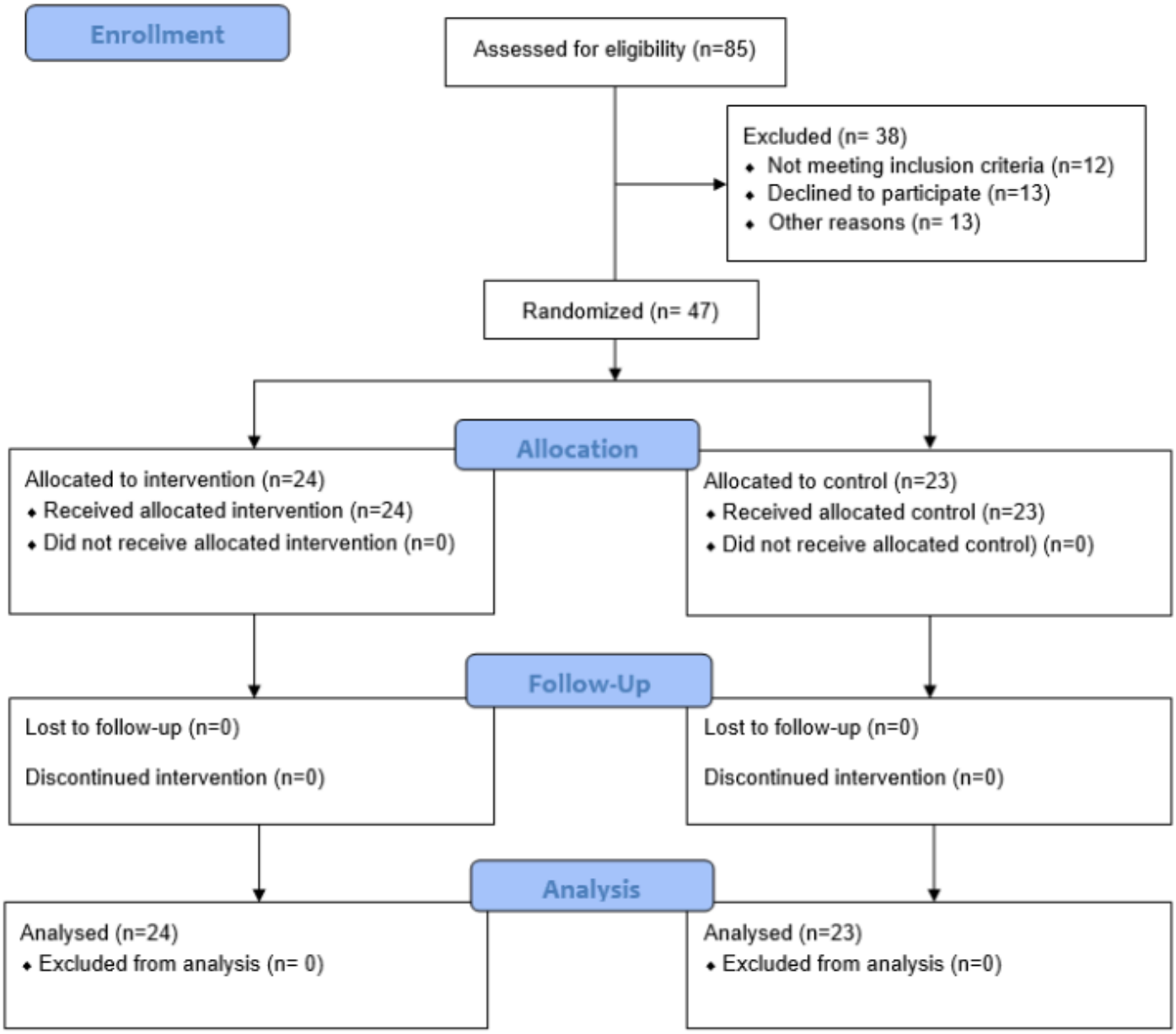


Figure 1

Flowchart