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State Anxiety and Self-Efficacy across Educational Stages, Including Clinical Practicum, in Japanese Rehabilitation Students: A 3-Year Longitudinal Study

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ABSTRACT: Background: Physical and occupational therapy students face academic and clinical stressors, but longitudinal changes in anxiety and its association with self-efficacy remain unclear. This study examined state anxiety across curriculum-based educational stages, including clinical practicum, and its association with self-efficacy in a Japanese cohort. **Methods:** This 3-year longitudinal observational study included 144 physical and occupational therapy students at one Japanese university. State anxiety (State-Trait Anxiety Inventory–Form JYZ) and General Self-Efficacy Scale (GSES) were assessed at six curriculum-aligned time points. A linear mixed-effects model included Time, gender, within-person GSES deviation, between-person mean GSES, and their interactions with Time as fixed effects and participant ID as a random intercept. **Results:** Mean state anxiety ranged from 37.5 to 42.8, highest during clinical practicum and lowest after first clinical contact. Time was significantly associated with anxiety ($F(5, 206.02) = 5.79$, $p < 0.001$; partial $\eta^2 = 0.123$), and anxiety was lower at first clinical contact than at early enrolment ($B = -4.24$, 95% CI: -6.30 to -2.19 ; $p < 0.001$). Time $\times$ within-person GSES ($F(5, 260.06) = 3.81$, $p = 0.002$) and Time $\times$ between-person mean GSES interactions ($F(5, 186.27) = 42.79$, $p < 0.001$) were significant. At early enrolment, higher between-person mean GSES was associated with lower anxiety, whereas within-person GSES deviation was not. During clinical practicum, both within-person and between-person GSES associations were positive; after practicum, the positive association remained only between persons. **Conclusions:** State anxiety and its associations with self-efficacy varied across curriculum-based stages. Curriculum-aligned monitoring and stage-specific support may be particularly relevant around clinical practicum.

KEYWORDS: State anxiety; self-efficacy; longitudinal study; rehabilitation students; mental health

1 Introduction

Previous studies on university student mental health have reported high prevalence rates of psychological problems, including anxiety and depression, which adversely affect academic performance, interpersonal relationships, and future occupational adaptation [1–3]. These conditions may impair students' ability to adjust to university life and persist in their studies, posing a substantial challenge for educational support systems. Students in physical and occupational therapy training programs experience elevated psychological stress due to clinical practicums, preparation for national examinations, and academic demands [4].

This stress extends beyond transient health effects and may contribute to academic underperformance, attrition, and difficulty adapting to professional roles.

Rather than implying that rehabilitation curricula are necessarily more demanding than those of other health professional programs, the present study focused on the specific sequence of educational demands encountered by students in physical and occupational therapy training. These demands include basic medical science courses, practical skills training, examinations, Objective Structured Clinical Examinations (OSCE), first clinical exposure, and supervised off-campus clinical practicums. In particular, clinical practicums require students to communicate with patients and supervisors, apply professional knowledge in real clinical settings, and demonstrate appropriate professional behavior under evaluation.

Consistent with this context, previous studies have reported substantial psychological distress among rehabilitation students, although estimates vary depending on country, assessment tool, and severity threshold. Specifically, the reported prevalence estimates for anxiety and depressive symptoms, respectively, were 84.7% and 84.7% among Pakistani physiotherapy students [5], 19.3% and 15.5% among Iranian rehabilitation students [6], 50.5% and 44.2% among Bangladeshi undergraduate rehabilitation students [7], and 68.5% and 48.0% among Pakistani undergraduate physiotherapy students [8]. In our previous cross-sectional study of first-year Japanese rehabilitation students, 56% showed state anxiety symptoms, 52% showed trait anxiety symptoms, and 23% showed mild depressive symptoms [9]. However, most existing evidence is derived from cross-sectional designs, limiting understanding of how anxiety evolves throughout the educational process. Moreover, temporal changes in the relationship between anxiety and associated factors remain unclear. Longitudinal follow-up of the same participants is therefore essential to capture dynamic changes in anxiety and its determinants. The novelty of the present study lies in its stage-based longitudinal approach. Rather than examining anxiety only by academic year or at a single point in time, this study followed the same cohort repeatedly across curriculum-based educational stages, including early enrolment, basic medical sciences, post-examination periods, first clinical contact, clinical practicum, and post-practicum completion. This design extends previous cross-sectional findings by identifying when anxiety varies during the educational trajectory and by examining whether the association between self-efficacy and state anxiety differs across stages.

Evaluation of psychological changes in these students requires consideration not only of academic year differences but also of the timing of key events, such as examinations, clinical practicums, OSCE, and national examination preparation. Training programs in physical and occupational therapy include multiple milestones, each with potential psychological impact. Among these milestones, clinical practicum is particularly important because it requires students to transition from classroom-based learning to real clinical settings. During clinical practicum, students are expected to communicate with patients and supervisors, apply professional knowledge and clinical reasoning, perform therapeutic procedures, and demonstrate appropriate professional behavior under evaluation. These demands may increase state anxiety because students must adapt to unfamiliar clinical environments while being assessed by clinical educators. Therefore, clinical practicum represents a theoretically and educationally relevant stage for examining changes in anxiety among rehabilitation students.

Self-efficacy may also play an important role in explaining individual differences in state anxiety during this educational trajectory. Bandura's Social Cognitive Theory provides a useful framework for understanding this relationship because it emphasizes reciprocal interactions among personal factors, behavior, and environmental demands. Within this framework, self-efficacy refers to an individual's belief in their capability to organize and execute actions required to manage specific situations [10–12]. Students with higher self-efficacy may appraise academic and clinical demands as manageable, engage in adaptive

coping behaviors, and experience lower affective arousal when facing evaluative or uncertain situations. In contrast, students with lower self-efficacy may perceive the same demands as threatening, which may contribute to higher state anxiety. The association between self-efficacy and anxiety can be considered at between-person and within-person levels. Between-person differences indicate whether students with higher average self-efficacy report lower average anxiety than other students, whereas within-person deviations indicate whether anxiety differs when a student's self-efficacy is higher or lower than their usual level. These associations are distinct and may vary across educational stages as students face different curriculum demands. Previous studies have reported negative associations between self-efficacy and anxiety among university and health professional students, including those exposed to examinations and clinical skill assessments [13–16]. However, it remains unclear whether within-person and between-person associations between self-efficacy and state anxiety differ across curriculum-based educational stages in rehabilitation students.

Based on this theoretical and educational background, we formulated the following hypotheses. First, state anxiety would fluctuate across curriculum-based educational stages rather than change linearly over time. Second, anxiety would be relatively high during stages involving greater evaluative or clinical demands, particularly clinical practicum. Third, higher average self-efficacy across students would be associated with lower state anxiety, and the within-person and between-person associations between self-efficacy and anxiety would differ across educational stages.

This study aimed to follow students in physical and occupational therapy training programs over 3 years to clarify longitudinal changes in state anxiety across curriculum-based educational stages, with particular attention to periods involving clinical exposure and clinical practicum. We also aimed to distinguish within-person deviations in self-efficacy from between-person differences in average self-efficacy and to examine whether their associations with state anxiety differed across educational stages. Using the early enrolment phase as the baseline, we examined how anxiety levels evolved across the educational trajectory. The findings are expected to extend previous cross-sectional evidence by identifying stage-related patterns of state anxiety and by informing the timing of student support according to curriculum milestones.

2 Methods

2.1 Study Design and Assessment Schedule

This longitudinal observational study included university students enrolled in physical and occupational therapy training programs. The same participants were followed for 3 years to assess longitudinal changes in anxiety and associated factors. Assessments were conducted twice annually—once during the first semester (April–September) and once during the second semester (October–March)—yielding six repeated assessments across the study period. Assessment timing was aligned with major curricular events rather than fixed dates. Following our previous study, assessments were scheduled outside regular examination periods to minimize the direct influence of imminent examinations on state anxiety [9]. Specifically, surveys were not administered during regular examination periods and, when scheduled before an examination period, were administered at least one month before the start of the examination. At all assessment points, data were collected using paper-based self-administered questionnaires. Students completed the questionnaires collectively in a classroom under the supervision of faculty members. Each time point represented a distinct educational stage: Time 1, university life adaptation (early enrolment stage); Time 2, pre-physiology practicum (basic medical sciences stage); Time 3, post-first-semester examination (learning load relief stage); Time 4, post-initial clinical exposure (first clinical contact stage); Time 5, clinical practicum (clinical practicum stage); and Time 6, post-clinical practicum (completion stage).

2.2 Participants

Participants comprised all 144 students enrolled in the physical therapy and occupational therapy majors within the Department of Rehabilitation at Fujita Health University in April 2022. The inclusion criterion was enrolment in the department. Students who refused to participate after receiving an oral explanation of the study purpose and procedures were not included. Students who withdrew from the university or repeated an academic year during follow-up were retained in the linear mixed-effects model when they had provided valid data at one or more assessment points, and all available observations were included in the analysis. The analytic sample therefore comprised all 144 students (83 male and 61 female students). At baseline, the mean age was 18.7 years (SD = 0.5; range, 18–20 years). All participants had entered through the standard educational pathway, and no non-traditional students were included.

The study was reviewed and approved by the institutional review board of Fujita Health University (approval number: HM25-654) and was conducted in accordance with the Declaration of Helsinki. The study objectives and procedures were orally explained to all participants, including the voluntary nature of participation, confidentiality, and the right to decline or withdraw at any time without penalty. Verbal informed consent was obtained before participation. Written informed consent was not required in accordance with national legislation and institutional requirements.

2.3 Assessments

Assessments of anxiety and self-efficacy were conducted to evaluate longitudinal changes and associated factors. Previous research has shown that mental health problems, including anxiety, are associated with academic functioning among university students [17,18], while self-efficacy is associated with anxiety [19].

2.3.1 State Anxiety

Anxiety was assessed using the State-Trait Anxiety Inventory (STAI) [20], a validated self-report instrument measuring state and trait anxiety. The STAI comprises two 20-item questionnaires, with each item rated on a four-point scale (1–4), yielding total scores of 20–80. Higher scores indicate greater anxiety. This study used the State-Trait Anxiety Inventory-Form JYZ (STAI-JYZ), which is adapted for Japanese populations [21]. The STAI-JYZ demonstrates high internal consistency, with Cronbach's α values of 0.87–0.92 for the state anxiety scale [21]. In the present study, we focused exclusively on state anxiety because the primary objective was to examine short-term, situation-dependent fluctuations in anxiety across curriculum-based educational stages. State anxiety reflects a transient emotional response to specific situational demands, such as examinations, clinical exposure, and clinical practicums, whereas trait anxiety represents a relatively stable individual predisposition to experience anxiety. Therefore, state anxiety was considered more appropriate for capturing temporal changes associated with educational milestones. Trait anxiety was not included because the study was designed to evaluate stage-specific changes rather than stable dispositional characteristics.

2.3.2 Self-Efficacy

Self-efficacy was measured using the General Self-Efficacy Scale (GSES) [22], which assesses an individual's belief in their ability to manage challenging tasks. The GSES includes 10 items rated on a four-point scale (1–4), with total scores ranging from 10 to 40; higher scores indicate greater self-efficacy. The GSES demonstrates strong internal consistency (Cronbach's α : 0.76–0.91) [23–25] and established construct validity [26]. The Japanese version of the GSES was used in this study [27].

2.4 Statistical Analysis

Descriptive statistics were calculated for all variables and presented as mean and standard deviation (SD). Longitudinal changes in state anxiety and associated factors were examined using a linear mixed-effects model (LMM). This approach accounts for within-individual correlations in repeated measures and enables likelihood-based estimation using all available data without requiring imputation for missing data [28–30].

In the LMM, state anxiety (STAI-JYZ) was specified as the dependent variable. Measurement time point (Time; six levels, categorical), gender, within-person GSES deviation (GSES_W), between-person mean GSES (GSES_B), and the interactions of Time with GSES_W and GSES_B were included as fixed effects. Participant ID was included as a random intercept. To distinguish within-person deviations in self-efficacy from between-person differences in average self-efficacy, GSES was decomposed into two components. For each participant, the participant-specific mean GSES score was calculated across all available assessment points. GSES_W was calculated as the GSES score at each assessment minus the participant-specific mean GSES score. Thus, GSES_W represented whether a student's self-efficacy at a given assessment was higher or lower than that student's usual level. GSES_B was calculated as the participant-specific mean GSES score minus the grand mean of the participant-specific mean GSES scores. The main effects of GSES_W and GSES_B represented their associations with state anxiety at the reference assessment point (Time 1, early enrolment stage). The Time $\times$ GSES_W interaction examined whether the within-person association between self-efficacy and state anxiety differed across educational stages. The Time $\times$ GSES_B interaction examined whether the between-person association between average self-efficacy and state anxiety differed across educational stages. Time 1 and female gender were used as the reference categories. Estimation was performed using restricted maximum likelihood (REML). Diagonal, first-order autoregressive [AR(1)], and unstructured residual covariance structures were compared using REML-based AIC and BIC. The unstructured model did not converge. The diagonal model had a lower AIC than the AR(1) model (5505.75 vs. 5510.56), whereas the AR(1) model had a lower BIC (5524.50 vs. 5538.28). Because the diagonal structure allowed residual variances to differ across assessment points and the estimated AR(1) residual correlation was small ($\rho = 0.083$), the diagonal residual covariance structure was retained for the final model. Denominator degrees of freedom for tests of fixed effects were estimated using the Satterthwaite approximation. Academic events were not directly included in the model as quantitative covariates because detailed event-level variables, such as days since the last examination, exact timing of clinical exposure, weeks into clinical practicum, practicum intensity, and academic workload, were not available. Therefore, Time was used as a curriculum-aligned categorical variable representing assessment timing, rather than as a direct measure of the effects of specific academic or clinical events. Baseline state anxiety was not included as a covariate because state anxiety at Time 1 was part of the repeated outcome structure. Instead, between-participant differences in overall anxiety levels were accounted for using the random intercept. Model assumptions were evaluated after model fitting. Residual histograms and normal Q–Q plots were inspected to assess residual normality, and residual-versus-fitted plots were inspected to assess homoscedasticity. Effect sizes were reported as standardized estimates for fixed-effect coefficients. For categorical variables, standardized estimates indicate adjusted differences in state anxiety expressed in SD units. For GSES_W, GSES_B, and their interaction terms, standardized estimates indicate standardized regression coefficients. Approximate partial eta squared values were also calculated from the Type III tests of fixed effects using the following formula: $\text{partial } \eta^2 = (F \times \text{df numerator}) / [(F \times \text{df numerator}) + \text{df denominator}]$. Statistical significance was set at $p < 0.05$. Analyses were conducted using SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA).

3 Results

A participant flowchart is shown in Fig. 1. Of the 144 eligible students at baseline, all 144 were retained in the analytic cohort. Students who withdrew from the university or repeated an academic year during follow-up were included when valid data were available. The number of valid respondents at each assessment was 144, 139, 132, 130, 131, and 128 for Times 1–6, respectively.

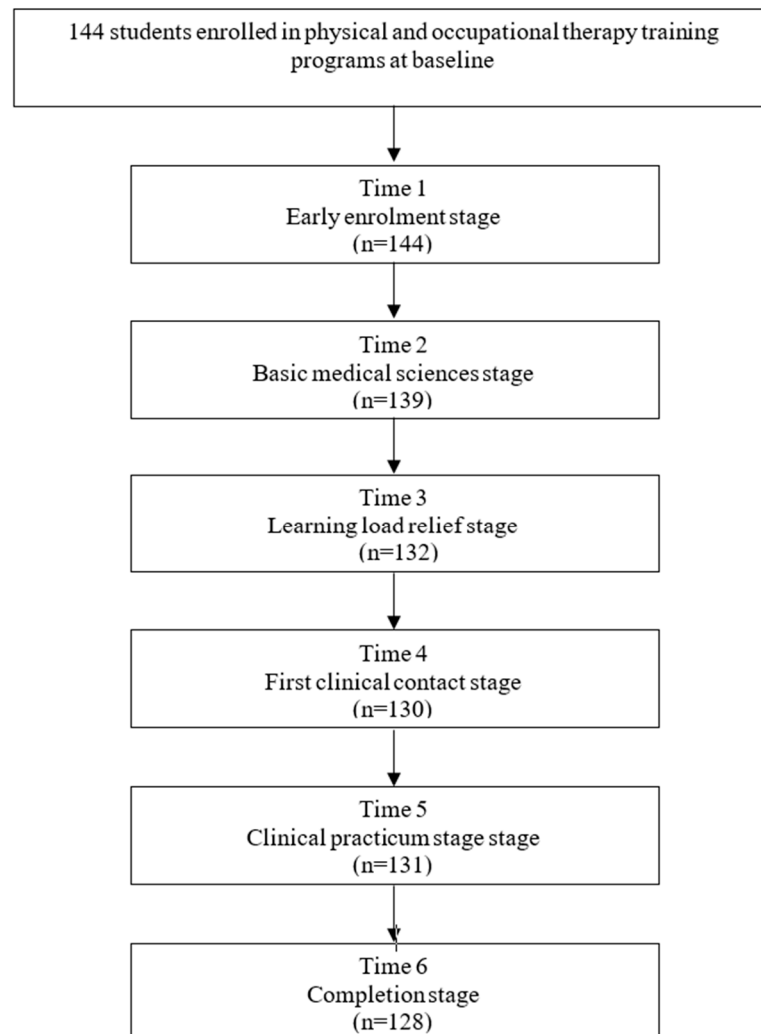


Figure 1: Participant flowchart.

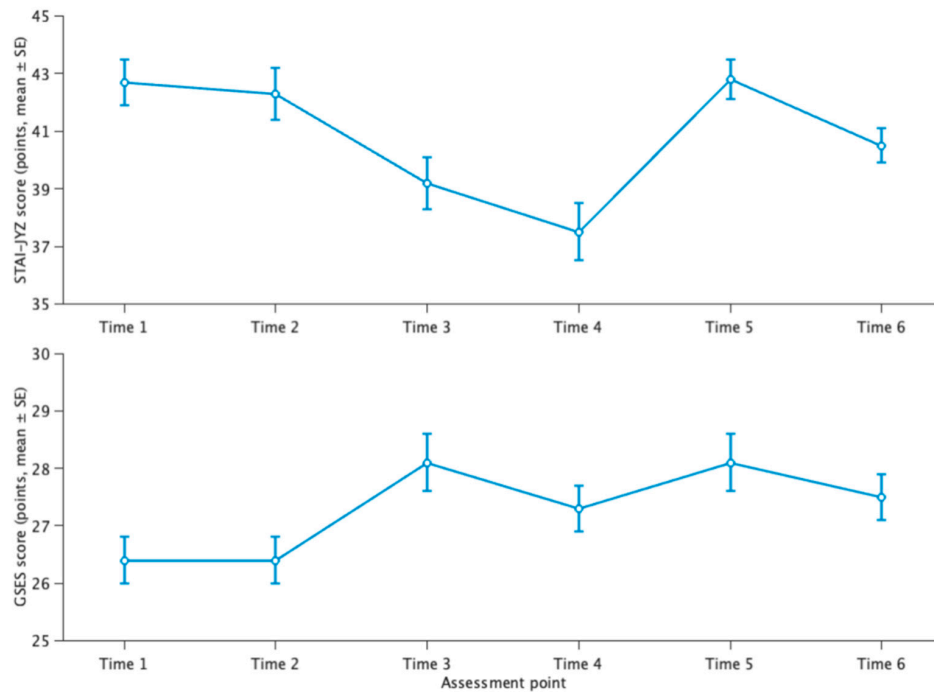
3.1 Descriptive Statistics of Psychological Measures at Each Assessment Point and Longitudinal Changes in Anxiety

Table 1 presents the mean and SD values for state anxiety and self-efficacy across the six assessments, and Fig. 2 illustrates longitudinal trends. Mean state anxiety scores ranged from 37.5 to 42.8. The highest level was observed at Time 5, corresponding to the clinical practicum stage (42.8 ± 7.7), followed by Time 1, corresponding to university life adaptation (42.7 ± 9.9). The lowest level was observed at Time 4, corresponding to first clinical contact stage (37.5 ± 11.1). Self-efficacy increased from Time 1 (26.1 ± 4.6) to Time 3 (28.1 ± 5.3) and remained relatively stable through Time 6.

Table 1: Descriptive statistics of psychological assessments at each stage.

Time	Academic Year/Month (Assessment Timing)	N	STAI-JYZ Mean (SD)	GSES Mean (SD)
Time 1	First year, June	144	42.7 (9.9)	26.1 (4.6)
Time 2	First year, January	139	42.3 (10.1)	26.3 (4.6)
Time 3	Second year, July	132	39.2 (10.1)	28.1 (5.3)
Time 4	Second year, March	130	37.5 (11.1)	27.3 (4.7)
Time 5	Third year, July	131	42.8 (7.7)	28.1 (5.4)
Time 6	Third year, February	128	40.5 (7.0)	27.5 (4.5)

Notes: Japanese academic year starts in April and ends in March. SD, standard deviation; STAI-JYZ, State-Trait Anxiety Inventory–Form JYZ, range: 20–80; GSES, General Self-Efficacy Scale, range: 10–40.

**Figure 2:** Longitudinal changes in state anxiety and self-efficacy across six assessment points.

Values are shown as means, and error bars indicate the SE. The sample size for each assessment was as follows: Time 1, $n = 144$; Time 2, $n = 139$; Time 3, $n = 132$; Time 4, $n = 130$; Time 5, $n = 131$; and Time 6, $n = 128$. The six assessments corresponded to distinct educational stages: Time 1, early enrolment stage; Time 2, basic medical sciences stage; Time 3, learning load relief stage; Time 4, first clinical contact stage; Time 5, clinical practicum stage; and Time 6, completion stage. STAI-JYZ, State-Trait Anxiety Inventory–Form JYZ; GSES, General Self-Efficacy Scale; SE, standard error.

3.2 Factors Associated with Anxiety Identified by the LMM

Type III tests of fixed effects showed significant main effects of time ($F(5, 206.02) = 5.79, p < 0.001$; partial $\eta^2 = 0.123$), gender ($F(1, 108.73) = 11.67, p < 0.001$; partial $\eta^2 = 0.097$), and between-person mean GSES (GSES_B; $F(1, 129.05) = 58.41, p < 0.001$; partial $\eta^2 = 0.312$). The overall effect of within-person GSES deviation (GSES_W) was not significant ($F(1, 528.78) = 0.88, p = 0.348$; partial $\eta^2 = 0.002$). Both the Time $\times$ GSES_W interaction ($F(5, 260.06) = 3.81, p = 0.002$; partial $\eta^2 = 0.068$) and the Time $\times$ GSES_B interaction ($F(5, 186.27) = 42.79, p < 0.001$; partial $\eta^2 = 0.535$) were significant. Fixed-effect estimates are

presented in Table 2. Compared with Time 1, adjusted state anxiety was significantly lower at Time 3 ($B = -2.18$, 95% CI: -4.14 to -0.22 , $p = 0.030$; standardized estimate = -0.23), Time 4 ($B = -4.24$, 95% CI: -6.30 to -2.19 , $p < 0.001$; standardized estimate = -0.44), and Time 6 ($B = -2.07$, 95% CI: -3.86 to -0.29 , $p = 0.023$; standardized estimate = -0.21). No significant differences from Time 1 were observed at Time 2 or Time 5. Male students had higher state anxiety than female students ($B = 2.44$, 95% CI: 1.02 to 3.85 , $p = 0.001$; standardized estimate = 0.25). At the reference stage (Time 1), within-person GSES deviation was not significantly associated with state anxiety ($B = -0.49$, 95% CI: -1.07 to 0.09 , $p = 0.097$; standardized estimate = -0.14). In contrast, higher between-person mean GSES was associated with lower state anxiety ($B = -1.16$, 95% CI: -1.50 to -0.83 , $p < 0.001$; standardized estimate = -0.49). The estimated within-person GSES slope was negative from Time 1 through Time 4, became positive at Time 5 ($B = 0.61$), and was close to zero at Time 6 ($B = 0.18$). The estimated between-person GSES slope was negative from Time 1 through Time 4, but became positive at Time 5 ($B = 0.55$) and Time 6 ($B = 0.73$). Compared with Time 1, the within-person GSES slope differed significantly at Time 5 (Time 5 $\times$ GSES_W: $B = 1.10$, 95% CI: 0.34 to 1.85 , $p = 0.004$; standardized estimate = 0.31), whereas the difference at Time 6 did not reach statistical significance (Time 6 $\times$ GSES_W: $B = 0.68$, 95% CI: -0.04 to 1.39 , $p = 0.063$; standardized estimate = 0.19). The between-person GSES slope differed significantly from Time 1 at both Time 5 (Time 5 $\times$ GSES_B: $B = 1.71$, 95% CI: 1.26 to 2.16 , $p < 0.001$; standardized estimate = 0.72) and Time 6 (Time 6 $\times$ GSES_B: $B = 1.89$, 95% CI: 1.47 to 2.31 , $p < 0.001$; standardized estimate = 0.79).

Table 2: Fixed effects from the linear mixed-effects model separating within-person and between-person associations of self-efficacy with state anxiety.

Fixed Effect	B	SE	95% CI	p-Value	Effect Size (Standardized Estimate)
Intercept	41.25	0.81	39.65 to 42.84	<0.001*	-
Time 2	0.14	1.03	-1.89 to 2.17	0.891	0.01
Time 3	-2.18	1	-4.14 to -0.22	0.030*	-0.223
Time 4	-4.24	1.04	-6.30 to -2.19	<0.001*	-0.44
Time 5	-0.17	0.96	-2.05 to 1.72	0.861	0.02
Time 6	-2.07	0.9	-3.86 to -0.29	0.023*	-0.21
Male gender	2.44	0.71	1.02 to 3.85	0.001*	0.25
Within-person GSES deviation (GSES_W)	-0.49	0.29	-1.07 to 0.09	0.097	-0.14
Between-person mean GSES (GSES_B)	-1.16	0.17	-1.50 to -0.83	<0.001*	-0.49
Time 2 $\times$ GSES_W	0.38	0.43	-0.47 to 1.22	0.384	0.11
Time 3 $\times$ GSES_W	-0.17	0.37	-0.89 to 0.55	0.645	-0.05
Time 4 $\times$ GSES_W	0.37	0.43	-0.48 to 1.22	0.394	0.11
Time 5 $\times$ GSES_W	1.1	0.38	0.34 to 1.85	0.004*	0.31
Time 6 $\times$ GSES_W	0.68	0.36	-0.04 to 1.39	0.063	0.19
Time 2 $\times$ GSES_B	-0.13	0.23	-0.59 to 0.33	0.577	-0.05
Time 3 $\times$ GSES_B	-0.13	0.24	-0.60 to 0.33	0.574	-0.06
Time 4 $\times$ GSES_B	-0.38	0.25	-0.87 to 0.11	0.131	-0.16
Time 5 $\times$ GSES_B	1.71	0.23	1.26 to 2.16	<0.001*	0.72
Time 6 $\times$ GSES_B	1.89	0.21	1.47 to 2.31	<0.001*	0.79

Note: B, unstandardized regression coefficient; SE, standard error; CI, confidence interval; GSES, General Self-Efficacy Scale. GSES_W was calculated as the GSES score at each assessment minus the participant-specific mean GSES score across all available assessments. GSES_B was calculated as the participant-specific mean GSES score minus the grand mean of the participant-specific mean GSES scores. Thus, GSES_W represents within-person deviations from each student's usual self-efficacy level, whereas GSES_B represents between-person differences in average self-efficacy. Time 1 and female gender were used as reference categories. The main effects of GSES_W and GSES_B represent their associations with state anxiety at Time 1. Interaction terms indicate differences in these associations relative to Time 1. For categorical variables, standardized estimates indicate adjusted differences in state anxiety expressed in standard deviation units. For GSES_W, GSES_B, and their interaction terms, standardized estimates were calculated using the SD of the corresponding GSES component and the SD of state anxiety. * $p < 0.05$.

4 Discussion

This longitudinal study followed university students in physical and occupational therapy training programs over 3 years to examine changes in state anxiety and its association with self-efficacy. Three principal findings emerged. First, state anxiety differed across curriculum-based educational stages. Second, state anxiety was significantly lower at the first clinical contact stage than at the early enrolment stage, although the magnitude of this difference was small to moderate. Third, the associations between self-efficacy and state anxiety were not constant across the educational trajectory and differed between within-person deviations in self-efficacy and between-person differences in average self-efficacy. At early enrolment, higher average self-efficacy across students was associated with lower state anxiety, whereas within-person deviations in self-efficacy were not significantly associated with anxiety. During clinical practicum, both within-person and between-person associations were positive, whereas after practicum, the positive association was observed only for between-person differences in average self-efficacy.

These findings add to the literature by applying a curriculum-stage perspective to longitudinal student mental health research and by distinguishing within-person changes in self-efficacy from between-person differences in average self-efficacy. Given the limited evidence on how state anxiety and its associations with self-efficacy change across specific educational stages in rehabilitation students, the present study provides a useful framework for interpreting anxiety and self-efficacy–anxiety associations in relation to curriculum-based milestones. This stage-based perspective may help educators identify periods when routine monitoring and timing-specific support should be considered, rather than relying only on general support throughout the curriculum, particularly during transitions to and from clinical practicum.

This stage-based interpretation should be considered in relation to the educational characteristics of physical and occupational therapy training. These programs require students to acquire medical knowledge, develop therapeutic skills, communicate with patients and supervisors, and apply clinical reasoning in real clinical settings. Although state anxiety at the clinical practicum stage was not significantly higher than that at early enrolment, the clinical practicum stage showed the highest descriptive anxiety level across the six assessments. This pattern may reflect the specific demands of rehabilitation education, including patient interaction, supervised performance, and application of therapeutic skills. However, this interpretation is contextual rather than causal because specific practicum-related demands were not directly measured. We do not assume that these findings are unique to physical and occupational therapy students. Other health professional students may also experience increased anxiety during clinical exposure, evaluation, and role transition. Because this study included only physical and occupational therapy students from one Japanese university, direct comparisons with other health professional programs were not possible. Therefore, the findings should be interpreted as evidence from a cohort of rehabilitation students, with potential relevance to similar practice-based health professional education contexts.

Analysis of longitudinal patterns showed that state anxiety was significantly lower at Time 3, Time 4, and Time 6 than at Time 1. Time 3 corresponded to the learning load relief stage, Time 4 to the period after initial clinical exposure, and Time 6 to post-clinical practicum completion. However, because specific academic or clinical events were not included as quantitative covariates in the model, these findings should be interpreted as differences between assessment points rather than evidence that any particular educational event directly reduced anxiety. The lower anxiety observed at these assessment points may reflect several contextual factors, including adaptation to university life, accumulated learning experience, relief from specific academic demands, or increased familiarity with clinical education. Thus, the labels assigned to each assessment point provide contextual information for interpreting the timing of assessments, but they do not establish causal effects of specific educational events on state anxiety. The magnitudes of the observed

differences should also be considered. Compared with Time 1, the adjusted differences in STAI-JYZ scores were approximately 2.2 points at Time 3, 4.2 points at Time 4, and 2.1 points at Time 6, corresponding to small standardized estimates at Times 3 and 6 and a small-to-moderate standardized estimate at Time 4. Therefore, although the findings suggest measurable variation in state anxiety across assessment points, they should not be interpreted as evidence of large or clinically meaningful reductions in anxiety. Rather, the results may be more useful for identifying periods when routine monitoring and stage-specific support should be considered. Previous studies involving rehabilitation or physiotherapy students have reported substantial psychological distress during academic and clinical training [5–8]. More broadly, studies of general university students or mixed student populations have shown that anxiety fluctuates around examinations and other evaluative events [31–34]. These findings are consistent with the present study in suggesting that student anxiety is sensitive to educational demands and evaluative contexts.

Several mechanisms may explain the observed variation in state anxiety across assessment points, although these mechanisms were not directly tested in the present model. Early in training, anxiety may reflect uncertainty about university life, academic expectations, and future professional roles. The lower anxiety observed at Times 3, 4, and 6 may partly reflect adaptation to the university environment, accumulated learning experience, temporary relief from particular academic demands, or increased familiarity with clinical education. In contrast, although anxiety at the clinical practicum stage was not significantly higher than at early enrolment, this stage showed the highest descriptive anxiety level across the six assessments and may involve distinct stressors, including direct patient interaction, communication with supervisors, supervised performance, and increased responsibility. These explanations should be regarded as contextual interpretations rather than causal conclusions because event-related variables were not included in the model.

The significant Time $\times$ GSES_W and Time $\times$ GSES_B interactions indicated that the association between self-efficacy and state anxiety differed across educational stages and between within-person and between-person effects. Previous studies have generally reported negative associations between self-efficacy and anxiety among university, physical therapy, and medical students [13–16]. Consistent with these findings, at Time 1, the between-person GSES slope was negative ($B = -1.16$), indicating that students with higher average GSES tended to report lower anxiety; however, the within-person slope was not significant ($B = -0.49$). During clinical practicum (Time 5), both slopes became positive (within-person: $B = 0.61$; between-person: $B = 0.55$). At Time 6, the within-person slope was small and not significant ($B = 0.18$), whereas the between-person slope remained positive ($B = 0.73$). Compared with Time 1, the within-person slope differed significantly at Time 5, whereas the between-person slope differed significantly at both Times 5 and 6. Thus, the conventional inverse association reported in previous studies was not uniform across educational stages in the present cohort. One possible explanation is reality shock during the transition from classroom-based learning to direct clinical practice. General self-efficacy reflects broad beliefs about one's capability to manage difficult situations but may not fully represent confidence in specific clinical tasks, such as communicating with patients and supervisors or making decisions under supervision. This interpretation is consistent with literature describing stress during transitions to clinical training when students encounter gaps between theoretical preparation, role expectations, and the realities of practice [35–37]. However, this explanation remains speculative because clinical performance, task-specific self-efficacy, workload, supervisor feedback, and perceived preparedness were not measured. Therefore, the observed associations should not be interpreted as evidence that higher self-efficacy increased anxiety.

These findings have practical implications for timing-specific student support. During early enrolment, support may focus on orientation to university life, clarification of academic expectations, and activities that strengthen students' confidence in managing learning demands. Before and during clinical practicum,

support may need to emphasize clinical preparedness, communication with supervisors and patients, graded exposure to clinical tasks, and structured feedback. After practicum, reflection sessions may help students integrate clinical experiences and identify remaining sources of anxiety. These implications should be interpreted cautiously because the study was conducted at a single Japanese university.

This study has several limitations. First, participants were recruited from a single university, and differences in curriculum structure, clinical practicum organization, and student support systems across institutions may limit generalizability. Second, although gender was included as a covariate, other potential confounding variables, such as academic performance, socioeconomic or financial status, prior mental health history, sleep quality, social support, interpersonal relationships, family coherence, and workload, were not available in the present dataset. Therefore, residual and unmeasured confounding cannot be ruled out. Third, although GSES was measured repeatedly and the analysis separated within-person deviations from between-person differences in average self-efficacy, the observational design does not establish temporal ordering or causal direction. It remains unclear whether changes in self-efficacy preceded changes in anxiety, whether anxiety influenced self-efficacy, or whether both were associated with unmeasured factors. Fourth, baseline state anxiety was not included as a separate covariate because state anxiety at Time 1 was modeled as part of the repeated outcome structure. Although the random-intercept model accounted for between-participant differences in overall anxiety levels, it did not allow us to determine whether such differences reflected trait anxiety or other stable individual characteristics. Future studies should measure both state and trait anxiety and include relevant person-level covariates. Fifth, potential bias related to incomplete follow-up should be considered. All 144 students were retained in the analytic cohort, including students who withdrew from the university or repeated an academic year when valid data were available, and the LMM used all available observations. However, the number of valid respondents varied across assessment points ($n = 128\text{--}144$). If missingness was associated with anxiety, academic adjustment, self-efficacy, or other psychological characteristics, the observed longitudinal pattern may have been affected. Sixth, although each assessment was aligned with major curriculum-based educational stages, the model treated Time as a categorical variable and did not include event-related covariates, such as days since the last examination, timing of clinical exposure, weeks into clinical practicum, practicum intensity, academic workload, or academic performance. Therefore, the observed differences between time points should be interpreted as differences between assessment points rather than causal effects of specific educational events. Future studies should incorporate curriculum-related and event-related variables to clarify how specific educational demands are associated with changes in state anxiety. Seventh, although the overall effect of Time was evaluated within a single linear mixed-effects model, no multiplicity adjustment was applied to the five time-point contrasts comparing Times 2–6 with Time 1. Therefore, the possibility of Type I error inflation in the time-point-specific findings cannot be ruled out, and these findings should be interpreted cautiously. Finally, this study relied on self-administered questionnaires, which may introduce response bias. We did not collect multi-method data, such as physiological stress indicators, including salivary cortisol levels [14], qualitative interview data, evaluations by clinical educator, or academic performance records. Therefore, the findings may not fully capture the physiological, behavioral, or experiential aspects of anxiety. Future studies should incorporate multiple data sources, including questionnaire-based assessments, physiological measures, and qualitative approaches, to provide a more comprehensive understanding of student anxiety during rehabilitation education.

5 Conclusions

This 3-year longitudinal study showed that state anxiety among physical and occupational therapy students at a single Japanese university varied across curriculum-based educational stages. State anxiety was significantly lower after initial clinical exposure than at early enrolment, whereas the highest descriptive anxiety level across the six assessments was observed during the subsequent clinical practicum stage. Associations between self-efficacy and anxiety also varied by stage. At early enrolment, higher average GSES was associated with lower anxiety; however, this negative association was not maintained during clinical practicum, when positive associations were observed for both within-person and between-person GSES. After practicum, the positive association remained only for between-person differences in average GSES. These findings support curriculum-aligned monitoring and support, particularly before and during clinical practicum. Generalizability should be interpreted cautiously because this was a single-institution study.

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Availability of Data and Materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval: The study involved human participants and was reviewed and approved by the institutional review board of Fujita Health University (approval number: HM25-654) and was conducted in accordance with the Declaration of Helsinki. The study objectives and procedures were explained to the participants, emphasizing voluntary participation, anonymity, confidentiality, and adherence to ethical standards. Participants were informed of their right to decline or withdraw at any time without penalty. Verbal informed consent was obtained before participation. Written informed consent was not required in accordance with national legislation and institutional requirements.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AR (1)	First-Order Autoregressive
CI	Confidence Interval
GSES	General Self-Efficacy Scale
GSES_B	Between-Person Mean GSES
GSES_W	Within-Person GSES Deviation
IBM	International Business Machines Corporation
LMM	Linear Mixed-Effects Model
OSCE	Objective Structured Clinical Examination
SD	Standard Deviation
SE	Standard Error

SPSS	Statistical Package for the Social Sciences
STAI	State-Trait Anxiety Inventory
STAI-JYZ	State-Trait Anxiety Inventory–Form JYZ

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