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Perceived Stress and Multidimensional Quality of Life Among Health Sciences Students at Taif University, Saudi Arabia: A Single-Institution Cross-Sectional Study

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Highlights

What are the main findings?

- Higher perceived stress was associated with lower physical, psychological, social, and environmental quality of life among health sciences students after accounting for reported academic, family, social, and financial difficulties.
- The association was strongest for psychological quality of life, and reported financial difficulty was associated with poorer scores in every domain.

What are the implications of the main findings?

- Assessments of student well-being in health sciences programs may benefit from measuring all four quality-of-life domains alongside perceived stress.
- Probability-based longitudinal studies are needed to establish the direction of these associations and to evaluate institutional support measures.

Abstract

Background/Objectives: Perceived stress is common among health sciences students and is inversely associated with quality of life (QoL). However, it is unclear whether this association extends to all 4 World Health Organization Quality of Life-BREF (WHOQOL-BREF) domains once students' academic, family, social, and financial difficulties are considered, and how much of the variance in each domain is uniquely associated with perceived stress. This study examined these domain-specific associations among undergraduate health sciences students. **Methods**: In this single-institution analytical cross-sectional study at Taif University, Saudi Arabia (June–September 2025), students from 5 programs were recruited by convenience and peer-referral sampling and completed an online questionnaire including the 10-item Perceived Stress Scale (PSS-10; range 0–40), the WHOQOL-BREF, and items on contextual difficulties. Hierarchical linear regression with robust standard errors adjusted for gender, academic year, program, and these difficulties; demographic-only models served as a sensitivity analysis. **Results**: Of 297 analyzed students (73.7% female), the mean PSS-10 score was 21.16 (SD 6.49), close to the scale midpoint. Higher PSS-10 scores were associated with lower scores in all 4 domains after adjustment (all Holm-adjusted $p < 0.001$). Adding perceived stress to the covariate models increased R^2 by 0.251 for psychological health, 0.179

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for physical health, 0.144 for environment, and 0.062 for social relationships. Reported financial difficulty was also associated with lower scores in all domains. Findings were robust in sensitivity analyses. **Conclusions**: Higher perceived stress was associated with poorer QoL across all domains, most strongly psychological health, beyond students' reported difficulties. Given the cross-sectional design and non-probability sample, these associations do not establish causality or prevalence; longitudinal studies in probability-based samples are needed.

Keywords: health sciences students; perceived stress; PSS-10; quality of life; Saudi Arabia; WHOQOL-BREF

1. Introduction

Students in health professions programs face demanding curricula, frequent high-stakes assessments, and supervised clinical training, alongside the developmental, social, and financial transitions of early adulthood [1,2]. A systematic review documented a substantial burden of depression, anxiety, and other indicators of psychological distress among medical students [3], and an integrative review of healthcare students across several disciplines identified stress and burnout as salient threats to their quality of life (QoL) [1].

Cohen et al. defined perceived stress as the degree to which individuals appraise situations in their lives as unpredictable, uncontrollable, or overloading; it therefore reflects how individuals evaluate the demands they face in relation to their resources, rather than the number of stressful events they experience [4]. The Perceived Stress Scale captures this appraisal [4]; its 10-item version (PSS-10) showed better psychometric properties than the original 14-item scale [5].

Among university students, elevated perceived stress has been associated with disturbed sleep, emotional difficulties, impaired concentration, and reduced academic engagement [6]. Because these consequences extend beyond emotional distress, QoL has been used as a complementary outcome that reflects students' functioning and satisfaction across several areas of life [7].

The World Health Organization (WHO) defines QoL as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns [8]. The WHOQOL-BREF operationalizes this definition by retaining 1 item from each of the 24 facets of the WHOQOL-100, grouped into 4 domains (physical health, psychological health, social relationships, and environment) [8,9]. Because this structure showed acceptable psychometric properties in the WHO international field trial [9], domain scores can be interpreted separately, allowing researchers to examine whether stress is more closely associated with some aspects of QoL than with others [9,10].

A systematic review by Ribeiro et al. of 13 studies of university students found that stress was consistently associated with poorer QoL [7]. In Saudi Arabia, Alkatheri et al. studied 479 students from 5 health professions disciplines in Riyadh: perceived stress correlated negatively with all 4 WHOQOL-BREF domains, but after adjustment for demographic and college-related factors, it remained independently associated only with the physical and psychological domains [10]. Alwhaibi et al. linked perceived stress to anxiety and depressive symptoms among Saudi healthcare students but did not examine QoL [11]. The Saudi evidence is therefore inconsistent for the social relationships and environment domains, and the results of Alkatheri et al. suggest that whether an association is observed in these domains depends on which other factors are taken into account.

This points to a second, analytical gap: previous studies have not quantified how much of the variance in each QoL domain is uniquely associated with perceived stress once students' personal circumstances are considered. Academic, family, social, and financial difficulties are particularly relevant because each has been linked to students' stress and well-being. Academic performance and pressure to succeed were among the most frequent concerns of college students with high levels of depression, anxiety, and stress [12], and academic expectations, workload, and examinations were major sources of academic stress [2]. Financial difficulties were linked to poorer mental health over time among British undergraduates [13], and family health was associated with stress and depression among university students [14]. Some also overlap with WHOQOL-BREF content, such as social support and financial resources [8].

How these difficulties should be handled in the analysis depends on their relationship with perceived stress. Because perceived stress reflects the appraisal of demands in relation to resources [4], the difficulties can be expected to precede and shape it; if they also affect QoL directly, they confound the association between stress and QoL, and adjustment is needed. The reverse ordering is also plausible: high stress may impair academic performance or strain relationships, placing the difficulties on the pathway between stress and QoL, so that adjusting for them would remove part of the association of interest. As a cross-sectional design cannot establish the ordering, comparing models with and without the difficulties shows how far the association depends on them, and the change in R^2 when perceived stress is added to the fully adjusted model gives a conservative, model-conditional estimate of the variance uniquely associated with stress.

Finally, among the Saudi studies described above, only Alkatheri et al. examined all 4 WHOQOL-BREF domains [10]. Studying 5 programs at a single university in Makkah Region allows comparison among students who share the same institutional environment. The present study addressed these 3 gaps. The primary objective was to estimate the association between perceived stress (PSS-10) and each of the 4 WHOQOL-BREF domain scores among undergraduate health sciences students at Taif University, after adjustment for gender, academic year, program, and self-reported academic, family, social, and financial difficulties, and to quantify the additional variance in each domain uniquely associated with perceived stress; models adjusted for gender, academic year, and program only were also estimated. We hypothesized that higher perceived stress would be associated with lower scores in all 4 domains. Secondary, exploratory objectives were to describe perceived stress and QoL and to examine the associations of the reported difficulties with QoL.

2. Materials and Methods

2.1. Study Design, Setting, and Participants

This analytical cross-sectional study was conducted among undergraduate students at Taif University, Saudi Arabia, and is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [15]. Students in any academic year of the Pharmacy, Medicine, Nursing, Dentistry, or Applied Health Sciences programs were eligible. Data were collected between 24 June and 18 September 2025 with a self-administered online questionnaire created in Google Forms, in which each item and response option was presented in English with an Arabic translation.

The study team and student representatives shared the survey link in WhatsApp and Telegram groups and invited recipients to forward it to eligible peers; recruitment was therefore by convenience and snowball sampling. Because the number of students who received the invitation was unknown, a response rate could not be calculated. The form required sign-in with a Google account and accepted only 1 response per account; email addresses were not collected. Respondents reported their university, program, and year of

study. The same form also received responses from students of another university, which were excluded; only responses from Taif University students were analyzed, and all records were checked against the eligibility criteria before analysis.

Convenience and snowball sampling were used for feasibility, as the approved protocol relied on student networks for recruitment. Although statistical representativeness is not strictly required for estimating associations [16,17], non-probability sampling can bias associations when participation is related to both the exposure and the outcome, and it limits the generalizability of descriptive estimates. These consequences are considered in Section 4.

English is the language of instruction in all 5 programs. The standardized instruments were presented with their original English wording and response options, each accompanied by an Arabic translation. The Arabic translations were prepared by the research team to support comprehension and were not formally validated. The questionnaire was piloted with 10 students from the target population, who completed it and commented on the clarity of the items and the time required for completion; their very minor comments were addressed before data collection without changes to the wording of the standardized instruments, and pilot responses were excluded from the analysis.

2.2. Sample Size

The recruitment target of 385 participants was calculated in the approved protocol with the single-proportion formula $n = Z^2 p(1-p)/d^2$, using 95% confidence ($Z = 1.96$), an anticipated proportion of 50%, and 5% precision, because the protocol included describing the level of perceived stress as an aim. This target was not derived from the primary regression analyses, and a regression-based calculation was not performed a priori. For reference, detecting a small incremental effect (Cohen $f^2 = 0.035$) of 1 coefficient in a model with 16 predictor parameters, with 80% power at the most stringent Holm-adjusted α of 0.0125, would require approximately 322 participants [18]. The sample size was therefore not matched to the primary analysis, which is a limitation of the study (Section 4.3).

As supplementary information, rather than as a justification of the achieved sample, a post hoc sensitivity power analysis using the noncentral F distribution indicated that, with 297 complete cases, the study had 80% power to detect a partial effect of $f^2 \geq 0.027$ (partial $R^2 \approx 0.026$) at $\alpha = 0.05$ and $f^2 \geq 0.038$ (partial $R^2 \approx 0.037$) at $\alpha = 0.0125$. These values describe the smallest effects that the achieved sample could detect; they do not imply that every analysis, particularly the exploratory secondary analyses, was adequately powered, and the precision of each estimate is indicated by its CI.

2.3. Measures

The self-administered online questionnaire began with an electronic informed consent item and comprised 4 sections: (1) demographic and academic characteristics (gender, program, year of study, and grade point average, which was not analyzed in this report); (2) current academic, family, social, and financial difficulties; (3) the PSS-10; and (4) the WHOQOL-BREF. All items used closed response formats.

Contextual difficulties were assessed with 4 items asking whether students were currently experiencing academic, family, social, or financial difficulties (yes/no). The items were developed by the research team on the basis of commonly reported sources of student stress and were reviewed by the investigators for relevance and clarity; no formal content validity index was calculated. Binary items were chosen to keep the questionnaire brief and to indicate the presence of each difficulty; they did not capture severity or duration, which is considered a limitation.

Perceived stress during the preceding month was measured with the original English version of the PSS-10 [4,5], whose reliability and validity have also been supported among English-speaking university students [19]. Participants rated each item from 0 (never) to 4 (very often); items 4, 5, 7, and 8 were reverse-scored, and total scores ranged from 0 to 40, with higher scores indicating greater perceived stress. Scores were analyzed as a continuous variable, as the PSS-10 has no validated diagnostic cut-offs.

QoL was measured with the WHO English version of the 26-item WHOQOL-BREF [8,20], whose psychometric properties were established in the WHOQOL international field trial, which included English-language versions [9], rated on 5-point scales. After reverse-coding items 3, 4, and 26, domain scores were calculated for physical health (items 3, 4, 10, and 15–18), psychological health (items 5–7, 11, 19, and 26), social relationships (items 20–22), and environment (items 8, 9, 12–14, and 23–25) as (mean item score − 1) × 25, giving a range of 0 to 100 in which higher scores indicate better QoL. In line with the WHO scoring guidance, the 2 general items (overall QoL, item 1; satisfaction with health, item 2) do not belong to any domain [20]; they were therefore analyzed separately on their original 1–5 scales, and no total score was computed.

All 10 PSS-10 items and all 26 WHOQOL-BREF items were included in the online form with their original English wording and 5-point response options. Each PSS-10 item stated its 1-month reference period ("In the last month"), whereas the WHOQOL-BREF section was presented without the standard WHO instructions, including the 2-week reference period; the implications are considered in Section 4.3. The form recorded item-level responses only; reverse-scoring and domain scores were calculated by the authors during analysis, using the procedures described above.

Cronbach α was calculated for the PSS-10 and for each WHOQOL-BREF domain as a sample-specific indicator of internal consistency. Because the WHOQOL-BREF measures 4 distinct domains, its reliability was assessed at the domain level.

2.4. Statistical Analysis

Responses were exported directly from Google Forms, so no manual data entry was required. Before analysis, records were checked for consent, eligibility, completeness, and patterned (straight-line) responses. One participant had a missing PSS-10 item and was excluded, giving an analytic sample of 297 complete cases; all descriptive and inferential results refer to this sample. Missing values were not imputed. Categorical variables are summarized as frequencies and percentages, and continuous variables as means, standard deviations (SDs), and observed ranges.

For the primary objective, Pearson correlations with Fisher z-based 95% confidence intervals (CIs) described the unadjusted associations between PSS-10 scores and each domain score, with Spearman correlations as a nonparametric check. Four hierarchical ordinary least squares models, 1 for each domain, then estimated the adjusted associations. Covariates were selected a priori because they are plausibly related to both perceived stress and QoL: gender, academic year (years 1–6 and internship year), and program describe students' demographic and training context, and the 4 contextual difficulties represent personal circumstances that previous studies have linked to students' stress and well-being [2,12–14] (Section 1). Block 1 entered these covariates (reference categories: male, first year, Pharmacy, and no difficulty), and block 2 added the continuous PSS-10 score.

Entering perceived stress last means that the change in R^2 (ΔR^2) quantifies the additional proportion of variance in each domain that is uniquely associated with perceived stress, given the covariates in the model; variance shared between stress and the covariates is attributed to the covariates. ΔR^2 is therefore conditional on the specified model and does not represent a causal contribution of stress. Because the difficulties may precede perceived

stress or result from it (Section 1), the models were also estimated with adjustment for gender, academic year, and program only.

We report unstandardized coefficients (B) with 95% CIs, standardized coefficients (β = B × SD of PSS-10/SD of the domain score), R^2, ΔR^2, and Cohen $f^2 = \Delta R^2/(1 - R^2$ of the full model), interpreted as small (0.02), medium (0.15), or large (0.35) [18]. Inference used heteroskedasticity-consistent (HC3) standard errors [21], and Holm correction was applied to the 4 primary PSS-10 coefficients [22]. Statistical significance was set a priori at $p < 0.05$ (2-sided).

For the secondary objectives, the associations of the contextual difficulties, gender, academic year, and program with each domain were taken from the same block 2 models. In total, 60 covariate coefficients (15 in each of the 4 models) were estimated; these were not adjusted for multiplicity, are regarded as exploratory, and some may be chance findings.

Model diagnostics comprised variance inflation factors (VIFs), residual plots, the Koenker test (an auxiliary regression of squared residuals) for heteroskedasticity, and a quadratic PSS-10 term for nonlinearity. In addition to the demographic-only adjustment described above, 3 sensitivity analyses were performed. First, potentially influential observations (Cook distance > 4/n) were excluded. Second, respondents who selected the same response option for all 10 PSS-10 items before reverse-scoring were excluded; because the PSS-10 contains both negatively and positively worded items, an identical response to every item is unlikely from an attentive respondent and was treated as possible inattentive (straight-line) responding. Third, the environment model was re-estimated after removing WHOQOL-BREF item 12 (adequacy of financial resources) to assess content overlap with the financial-difficulty covariate. Finally, because Pharmacy students formed more than half of the sample, we examined in exploratory analyses whether the PSS-10 coefficient differed between programs, using a joint Wald test of PSS-10 × program interaction terms and a model with a PSS-10 × Pharmacy interaction that gave separate coefficients for Pharmacy and non-Pharmacy students. Analyses were conducted in Python (version 3.12; Python Software Foundation). The analysis plan was not prospectively registered.

2.5. Ethical Considerations

The study was approved by the Scientific Research Ethics Committee of Taif University (application no. 46-349; approved on 24 June 2025). Participants provided electronic informed consent before beginning the questionnaire, and records without consent were excluded. No names, university identification numbers, email addresses, or other direct identifiers were collected, and data were stored in password-protected files.

3. Results

3.1. Participant Characteristics

The survey yielded 300 records from Taif University students. After 2 records without consent were excluded, 298 students were eligible, and 1 participant with an incomplete PSS-10 response was excluded, leaving an analytic sample of 297 (Figure 1). Of these, 219 (73.7%) were women, Pharmacy students formed the largest group (53.9%), and most students (64.6%) were in years 3 to 5. Academic difficulty was the most frequently reported contextual difficulty (34.3%) and family difficulty the least frequent (26.3%) (Table 1).

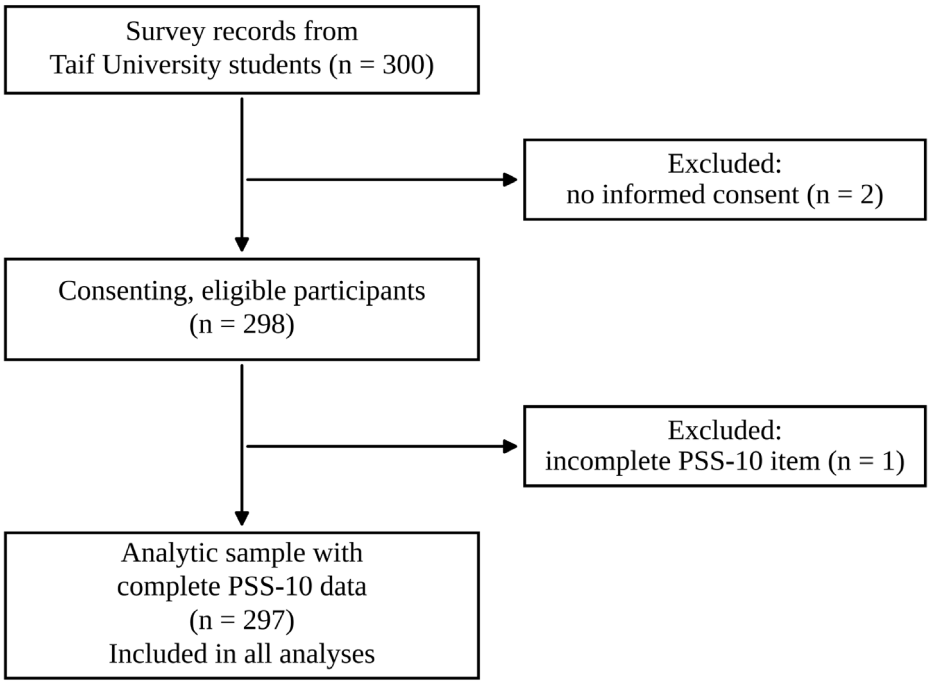

Figure 1. Participant flow. PSS-10, 10-item Perceived Stress Scale.

Table 1. Participant characteristics and contextual difficulties (n = 297).

Characteristic	Category	n	%
Gender	Female	219	73.7
	Male	78	26.3
Year of study	1	30	10.1
	2	25	8.4
	3	61	20.5
	4	65	21.9
	5	66	22.2
	6	43	14.5
	Internship	7	2.4
Program	Applied Health Sciences	50	16.8
	Dentistry	21	7.1
	Medicine	25	8.4
	Nursing	41	13.8
	Pharmacy	160	53.9
Academic difficulty	No	195	65.7
	Yes	102	34.3
Family difficulty	No	219	73.7
	Yes	78	26.3
Social difficulty	No	218	73.4
	Yes	79	26.6
Financial difficulty	No	209	70.4
	Yes	88	29.6

Contextual difficulties were recorded as separate, non-mutually exclusive indicators. Internship refers to students in 5-year programs (Nursing, Dentistry, and Applied Health Sciences) completing their internship year.

3.2. Perceived Stress, Quality of Life, and Internal Consistency

The mean PSS-10 score was 21.16 (SD 6.49), close to the midpoint (20) of the possible range of 0 to 40, and 48.8% of students scored above 20. Among the QoL domains, psychological health had the lowest mean score and social relationships had the greatest variability

(Table 2). Internal consistency was acceptable for the PSS-10 (Cronbach α = 0.844) and for each domain, ranging from 0.714 for social relationships to 0.831 for environment.

Table 2. Perceived stress, quality-of-life domain scores, and internal consistency (n = 297).

Measure	Mean	SD	Observed Range	Cronbach α
PSS-10	21.16	6.49	0–40	0.844
Physical health	60.53	17.47	3.57–100.00	0.776
Psychological health	57.45	18.81	0.00–95.83	0.825
Social relationships	59.93	22.43	0.00–100.00	0.714
Environment	60.45	17.80	6.25–100.00	0.831
Overall quality of life (item 1)	3.67	0.88	1–5	—
Satisfaction with health (item 2)	3.55	1.08	1–5	—

Scoring and score ranges are described in Section 2.3. SD, standard deviation; PSS-10, 10-item Perceived Stress Scale.

3.3. Unadjusted Associations

PSS-10 scores were inversely correlated with all 4 domain scores, most strongly with psychological health and least strongly with social relationships; Spearman coefficients showed the same pattern (Table 3).

Table 3. Unadjusted correlations between perceived stress and quality-of-life domain scores (n = 297).

Domain	Pearson r	95% CI	*p*	Spearman ρ
Physical health	−0.549	−0.624 to −0.465	<0.001	−0.517
Psychological health	−0.608	−0.675 to −0.531	<0.001	−0.565
Social relationships	−0.332	−0.430 to −0.227	<0.001	−0.306
Environment	−0.472	−0.556 to −0.379	<0.001	−0.433

CI, confidence interval (Fisher z transformation).

3.4. Adjusted Associations

After adjustment for gender, academic year, program, and contextual difficulties, higher PSS-10 scores remained associated with lower scores in every domain (all Holm-adjusted $p < 0.001$; Table 4; Figure 2). On the 0–100 domain scale, each 1-point higher PSS-10 score was associated with 0.97 to 1.63 points lower QoL. The standardized associations were largest for psychological health (β = −0.56) and physical health (β = −0.47), intermediate for environment (β = −0.43), and smallest for social relationships (β = −0.28). Correspondingly, adding the PSS-10 score to the covariate models produced a large increase in explained variance for psychological health ($f^2 = 0.43$), medium increases for physical health (0.28) and environment (0.24), and a small increase for social relationships (0.08) [18]. These increases describe statistical associations conditional on the covariates and do not indicate the extent to which stress causes differences in QoL.

Table 4. Hierarchical model fit and adjusted associations of perceived stress with quality-of-life domain scores (n = 297).

Domain	R^2 Block 1	R^2 Block 2	ΔR^2	f^2	B (95% CI)	β	Holm *p*
Physical health	0.190	0.369	0.179	0.28	−1.27 (−1.57, −0.97)	−0.47	<0.001
Psychological health	0.169	0.420	0.251	0.43	−1.63 (−1.94, −1.31)	−0.56	<0.001
Social relationships	0.174	0.237	0.062	0.08	−0.97 (−1.47, −0.46)	−0.28	<0.001
Environment	0.259	0.403	0.144	0.24	−1.17 (−1.49, −0.84)	−0.43	<0.001

Models are described in Section 2.4; block 1 contains the covariates and block 2 adds the PSS-10 score. B, change in domain score per 1-point higher PSS-10 score, with 95% CI based on HC3 standard errors; β, standardized coefficient; f^2, Cohen f^2 for ΔR^2. CI, confidence interval; HC3, heteroskedasticity-consistent (type 3); PSS-10, 10-item Perceived Stress Scale.

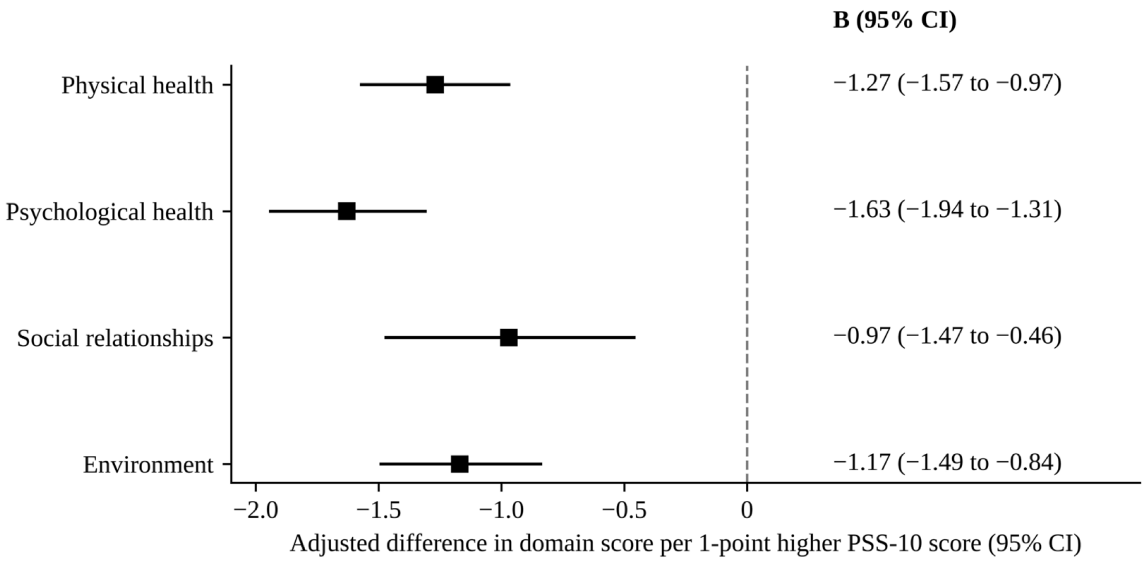

Figure 2. Adjusted associations between perceived stress and the 4 quality-of-life domain scores (n = 297). Points show the change in domain score per 1-point higher PSS-10 score, and bars show 95% confidence intervals; models are described in Section 2.4. PSS-10, 10-item Perceived Stress Scale.

3.5. Contextual Difficulties and Other Covariates

Among the exploratory covariates (Tables S1–S4), reported financial difficulty was associated with lower scores in all 4 domains, with the largest difference for environment (B = −13.06; 95% CI −17.30 to −8.82). Academic difficulty was associated with lower physical health scores only, and family and social difficulties were not associated with any domain. Compared with Pharmacy students, Nursing students had lower social relationships and environment scores, and Medicine and Applied Health Sciences students had lower environment scores; Dentistry students did not differ from Pharmacy students in any domain. Women had higher environment scores than men. Because 60 covariate coefficients were estimated without adjustment for multiple comparisons, some of these associations may be chance findings, and all should be interpreted cautiously.

3.6. Diagnostics and Sensitivity Analyses

Diagnostics indicated no material multicollinearity, heteroskedasticity, or departure from linearity (Table 5). The PSS-10 coefficients were robust across sensitivity analyses: they were larger when only gender, academic year, and program were adjusted for (B = −1.80 to −1.22; ΔR^2 = 0.119 to 0.367), and virtually unchanged after excluding influential observations or the 19 straight-line responders (6.4%), 17 of whom selected the midpoint response for every item. Removing item 12 from the environment domain attenuated the financial-difficulty coefficient from −13.06 to −11.34 (95% CI −15.75 to −6.92), whereas the PSS-10 coefficient was essentially unchanged (−1.22). In exploratory analyses by program, the PSS-10 coefficient for physical health was larger among Pharmacy students (B = −1.46; 95% CI −1.86 to −1.06) than among other students (B = −0.94; 95% CI −1.30 to −0.58; p = 0.043), whereas the differences for the other domains were small (p = 0.47 to 0.72). Joint tests of the PSS-10 × program interactions gave p values of 0.029 to 0.660, and no difference was statistically significant after Holm correction across the 4 domains.

Table 5. Model diagnostics and sensitivity analyses for the perceived stress coefficients.

Domain	Max VIF	Koenker *p*	Quadratic *p*	B, Demographic Only	B, Influential Excluded	B, Straight-Line Excluded
Physical health	2.76	0.68	0.70	−1.48	−1.30	−1.25
Psychological health	2.76	0.53	0.20	−1.80	−1.63	−1.62
Social relationships	2.76	0.74	0.77	−1.22	−1.01	−0.94
Environment	2.76	0.86	0.89	−1.38	−1.13	−1.15

Diagnostics and sensitivity analyses are described in Section 2.4. Main-model B values are shown in Table 4. Demographic adjustment includes gender, academic year, and program only. Influential observations (Cook distance > 4/n; 19, 18, 22, and 12 cases in the 4 models, respectively) were excluded with the original covariates retained. The straight-line analysis excluded 19 respondents (n = 278). All sensitivity coefficients had $p < 0.001$. B, unstandardized coefficient for the PSS-10 score; VIF, variance inflation factor; PSS-10, 10-item Perceived Stress Scale.

4. Discussion

4.1. Main Findings

In this sample of health sciences students, higher perceived stress was associated with lower QoL in all 4 WHOQOL-BREF domains after adjustment for demographic, academic, and contextual factors. The association was largest for psychological health and smallest for social relationships. The additional variance explained by perceived stress describes how much of the variation in QoL was statistically associated with stress beyond the covariates included; it is conditional on the specified model and does not indicate the proportion of QoL that is caused by stress. The mean PSS-10 score was close to the midpoint of the scale. Because the PSS-10 has no validated diagnostic cut-offs and the sample was not representative, this value should not be interpreted as a clinical threshold or as an estimate for all Taif University students.

4.2. Main Discussion

The inverse associations are consistent with the systematic review by Ribeiro et al. [7], which found that stress was associated with poorer QoL among university students, and with the integrative review of healthcare students by Di Mario et al. [1]. In Saudi health professions students, Alkatheri et al. [10] also reported negative correlations between perceived stress and all 4 WHOQOL-BREF domains, but after adjustment for demographic and college-related factors, perceived stress remained independently associated only with the physical and psychological domains. In contrast, we observed adjusted associations in all 4 domains. This difference may reflect the use of the 14-item rather than the 10-item scale, different covariate sets, or differences in sample composition; absolute scores and coefficients are therefore not directly comparable. Alwhaibi et al. [11] reported that perceived stress was associated with anxiety and depressive symptoms among Saudi healthcare students; these outcomes are distinct from QoL but point in the same direction.

The ranking of domains should be regarded as descriptive. We did not formally test whether the associations differed between domains, and the approximate 95% CIs of the standardized coefficients, obtained by rescaling the CIs of B, overlapped for psychological health ($\beta = -0.56$; -0.67 to -0.45), physical health ($\beta = -0.47$; -0.58 to -0.36), and environment ($\beta = -0.43$; -0.54 to -0.31). Differences between domains may also partly reflect their measurement characteristics. The psychological domain includes positive and negative feelings, concentration, and self-esteem, which are conceptually close to the feelings of being overwhelmed and unable to cope captured by the PSS-10; part of the stronger association may therefore reflect overlapping content. The social relationships domain has only 3 items and had the lowest internal consistency in this sample ($\alpha = 0.714$); because lower reliability attenuates observed associations, the smaller coefficient may partly

reflect less precise measurement. These explanations are plausible but untested, and the ranking does not indicate that psychological support should take priority over social or environmental support.

In models adjusted only for gender, academic year, and program, the PSS-10 coefficients ranged from −1.80 to −1.22 (Table 5). Adding the 4 reported difficulties to these models reduced the coefficients by approximately 10% (psychological health) to 21% (social relationships). Because the difficulties may precede perceived stress or result from it, neither estimate can be regarded as the effect of stress. Taken together, however, they indicate that the association between perceived stress and QoL remained after the difficulties that students reported were taken into account.

Financial difficulty, reported by 29.6% of students, was associated with lower scores in all domains, most markedly for environment. This is consistent with the longitudinal study by Richardson et al. [13], which linked financial difficulties to poorer mental health among British undergraduate students. Because the environment domain includes the perceived adequacy of financial resources, part of this association may reflect overlapping content; however, removing that item attenuated the coefficient only modestly, indicating that the association is not solely an artifact of shared item content. The single yes/no item could not distinguish tuition, living, transport, or household costs, so more specific measures are needed to identify which financial pressures matter.

The remaining covariate associations were exploratory and were not adjusted for multiple testing, so some may be chance findings. Academic difficulty was associated only with physical health, and family and social difficulties showed no adjusted associations. These results should not be taken to mean that family or social circumstances are unimportant, because broad binary items capture complex experiences poorly, and mutual adjustment for correlated difficulties can attenuate individual estimates. Program differences are similarly difficult to interpret, given small and unequal subgroups and possible confounding by stage of training.

Two design features limit the interpretation of these findings. First, because participants were recruited by convenience and peer referral, the associations may be affected by selection bias of unknown direction (Section 4.3) and require replication in probability-based samples. Second, because stress and QoL were measured at the same time, the associations are compatible with several causal structures: stress may impair functioning and well-being; poor physical health, limited social support, or adverse living conditions may generate stress; or both may share upstream determinants, such as workload, sleep, or financial strain, that were measured crudely or not at all. As discussed by Savitz and Wellenius [23] and by Wang and Cheng [24], cross-sectional data contribute to causal reasoning mainly when the temporal ordering of exposure and outcome is secure on other grounds, which is not the case for 2 concurrently assessed perceptual constructs. We therefore interpret the regression coefficients as conditional descriptions of how QoL differs across levels of perceived stress within this sample.

These findings do not identify which interventions universities should implement, and the domain-specific associations do not show which targets would be most effective. Locally, they may inform a needs assessment, for example by monitoring several QoL domains alongside perceived stress and by examining financial difficulty more closely as a correlate of poorer QoL. Potential strategies, such as counseling, mindfulness training, changes to academic scheduling, or financial assistance, would require participatory assessment with students and prospective evaluation before being recommended. Intervention studies, such as the randomized trial of mindfulness training by Galante et al. [25], have mainly targeted stress and psychological distress, and reviews report potential but heterogeneous benefits of student well-being interventions [26–29]; whether such interventions improve QoL across

all 4 domains among Saudi health sciences students remains to be tested. The next steps are longitudinal studies using probability-based sampling from enrollment registers stratified by college and academic year, with repeated measurement across the academic year and more detailed measures of sleep, coping, social support, workload, financial strain, and help-seeking, followed by controlled evaluations of student-support programs that include QoL outcomes.

4.3. Strengths and Limitations

Strengths of this study include the inclusion of 5 health sciences programs, the use of established multidimensional instruments scored by standard procedures, domain-level analysis, robust inference with multiplicity control for the primary hypothesis, and several sensitivity analyses.

Several limitations should be considered. Most importantly, convenience and snowball sampling may have introduced selection bias if participation depended on students' stress or QoL [16,17]; for example, students with high stress may have been more motivated to respond to a well-being survey, or less able to do so. The direction and magnitude of this bias cannot be determined, and clustering of respondents within social networks may have made the CIs narrower than they should be; the response rate also could not be calculated. Women (73.7%) and Pharmacy students (53.9%) were overrepresented, so the pooled estimates are weighted toward these groups and may not apply equally to all programs. Exploratory analyses suggested that the association with physical health may have been stronger among Pharmacy than among other students, although no difference between programs was statistically significant after correction for multiple testing, and estimates for the smaller programs were imprecise. In addition, the sample size was not calculated for the primary regression analyses, and the achieved sample of 297 was smaller than both the protocol target of 385 and the approximately 322 participants that a regression-based calculation would have required (Section 2.2). Second, the contextual difficulties were measured with brief, unvalidated binary items that did not capture severity or duration. Adjustment for them was therefore imprecise and may have left residual confounding, their own associations with QoL may be underestimated, and the financial item overlaps conceptually with the environment domain. Third, each item was presented in English with an Arabic translation that had been prepared by the research team and not formally validated; students may have relied on either language, and some may have misunderstood items. This would add measurement error, which would most likely attenuate the associations, although differential misunderstanding cannot be excluded. In addition, the WHOQOL-BREF was administered without the standard instructions, including the 2-week reference period, so students may have rated their QoL over different periods. This may limit the comparability of the domain scores with those of other studies, and its effect on the within-sample associations is uncertain.

Other limitations include the cross-sectional design (Section 4.2) and the concurrent self-report of stress and QoL, which may introduce common-method bias. Age, sleep, workload, baseline health, coping resources, and use of support services were not available. Gender was included as a covariate, but sex-stratified models were not estimated because of the limited number of men (n = 78). Finally, the analysis plan was not prospectively registered, and secondary analyses were exploratory.

4.4. Conclusions

Among health sciences students at Taif University, higher perceived stress was associated with lower physical, psychological, social, and environmental QoL beyond the demographic, academic, and contextual factors measured, with the strongest association

for psychological health. Reported financial difficulty was associated with poorer QoL across domains. These findings suggest that assessments of student well-being could include multiple QoL domains, but they do not show that reducing stress would improve QoL. Probability-based, longitudinal, and intervention studies are needed to establish generalizability, temporal direction, and the effects of institutional support.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/healthcare14234081/s1, Table S1: Adjusted associations of perceived stress and covariates with physical health quality-of-life scores; Table S2: Adjusted associations of perceived stress and covariates with psychological health quality-of-life scores; Table S3: Adjusted associations of perceived stress and covariates with social relationships quality-of-life scores; Table S4: Adjusted associations of perceived stress and covariates with environment quality-of-life scores.

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