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Modifiable lifestyle and psychosocial determinants of happiness among undergraduate medical and dental students in South India: a cross-sectional study

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Abstract

Background

Happiness is a measurable dimension of wellbeing distinct from psychiatric morbidity, with limited evidence on its modifiable lifestyle and psychosocial correlates among Indian medical and dental students when multiple factors are considered together.

Methods

This cross-sectional study was conducted among undergraduate medical and dental students at a single academic institution in South India. Of 526 respondents, 496 gave consent and completed the 29-item Oxford Happiness Questionnaire (OHQ-29). OHQ-29 total score was regressed on 19 sociodemographic, lifestyle, and psychosocial covariates by complete-case analysis (N = 312), with relative importance, interaction, and sensitivity analyses, including multiple imputation for missing body mass index data.

Results

Mean OHQ-29 total score was 111.5 ± 20.7 (Cronbach's α = 0.894). The model accounted for 43.7% of score variance (adjusted R^2 = 0.385). After adjustment, lower scores were associated with poorer sleep quality (poor/very poor versus excellent: β = -26.0, 95% CI -34.8 to -17.2), a fair/poor family relationship (β = -9.2, 95% CI -17.1 to -1.4), and recreational drug use (β = -8.0, 95% CI -15.1 to -1.0). Higher scores were associated with extracurricular participation (β = 9.2, 95% CI 4.8 to 13.7), a large friends circle (β = 9.4, 95% CI 2.3 to 16.5), good peer relationship (β = 8.2, 95% CI 3.0 to 13.4), and academic satisfaction (β = 6.7, 95% CI 1.0 to 12.3). Sleep quality accounted for the largest share of explained variance (10.3%). These associations were consistent across sensitivity analyses; an alcohol-use association in the primary model attenuated below conventional significance under multiple imputation and was not treated as established. Age, gender, course, body mass index, and physical activity showed no independent association.

Conclusions

Sleep quality, peer and family relationships, friends-circle size, academic satisfaction, extracurricular participation, and recreational drug use were independently associated with happiness among medical and dental students, with sleep quality linked to the largest share of explained variance. These cross-sectional findings may inform institution-level approaches to student wellbeing assessment in domains related to sleep, academic experience, and peer connectedness.

Background

Happiness is increasingly recognized as a distinct dimension of wellbeing rather than merely the absence of psychological distress [1]. Among health-profession students, happiness has been associated with academic engagement, interpersonal functioning, and the broader capacity to sustain demanding training over multiple years [2]. In addition to tracking psychological distress, measuring self-reported happiness helps identify factors that support sustained student well-being throughout professional education [1].

Medical and dental students undergo a training that combines a sustained academic workload with early and repeated exposure to clinical environments, patient suffering, and performance-based assessment [3]. This combination of academic and psychosocial demand is not uniformly experienced across all student populations and has been described as distinctive to health-profession education, in which preclinical coursework, clinical postings, and internship responsibilities accumulate within a comparatively compressed training period [4]. These create a context in which lifestyle behaviours, peer and family relationships, and academic experience may each carry particular relevance to a student's day-to-day wellbeing, independent of whether that student meets criteria for a diagnosable psychological condition [5].

Most existing literature on the wellbeing of medical and dental students are through the lens of psychiatric morbidity, characterizing the prevalence of depression, anxiety, and burnout within these populations [3]. While previous research effectively documents mental health morbidity, the absence of a diagnosed disorder does not imply well-being [2]. Focusing solely on disorder prevalence overlooks the lifestyle and psychosocial factors that foster happiness among non-distressed students. Analyzing happiness as a continuous measure, rather than merely the absence of illness, allows us to evaluate lifestyle and psychosocial determinants across the entire student population [6].

A body of cross-sectional research, including studies conducted among medical, dental, and nursing students in India and in other settings, has examined correlates of happiness using validated instruments such as the Oxford Happiness Questionnaire [7–10]. This study has identified associations between happiness and factors including sleep quality [11], peer and family relationships [12], physical activity [13], and substance use, with the specific pattern and strength of these associations varying across populations and methodology. Many of these studies have relied on bivariate or unadjusted analyses, or have dichotomized happiness into categorical groups, which limits the extent to which the independent contribution of each factor, after accounting for the others, can be characterized.

However, studies regarding Indian medical and dental students remains limited, as few studies have simultaneously adjusted for both lifestyle and psychosocial determinants of happiness. This gap is relevant because lifestyle and psychosocial factors, in contrast to fixed sociodemographic characteristics, represent domains that are modifiable by institutional attention. Identifying which of these factors carry independent and comparatively greater explanatory relevance to happiness, after adjustment for the others, is a necessary step that has not been comprehensively addressed for this population.

Medical and dental training provides a strategic window for public health intervention, as institutions maintain continuous contact with students [12]. Identifying the independent associations and relative effects of modifiable lifestyle and psychosocial factors on happiness, rather than focusing solely on morbidity surveillance, can directly inform institutional well-being programs [15]. Distinguishing these modifiable determinants from fixed demographic characteristics is essential for developing actionable, population-level strategies.

The objective of this study was to identify the modifiable lifestyle and psychosocial factors independently associated with happiness, measured using the Oxford Happiness Questionnaire, among undergraduate medical and dental students at a single academic institution in South India, and to characterize the relative contribution of these factors after adjustment for sociodemographic and other covariates.

Methods

Study design and setting

This was a cross-sectional study conducted among undergraduate students enrolled in medical (MBBS) and dental (BDS) degree programmes at a single academic health-sciences institution in South India between October, 2023 to February, 2024.

Participants and sampling

Eligible participants were undergraduate medical and dental students at the study institution who provided informed consent and completed a self-administered structured questionnaire.

Of 526 questionnaires submitted, 30 (5.7%) were excluded because consent had been declined or left incomplete, leaving an analytic sample of 496 participants. Students in their final year of training or undergoing a compulsory internship (MBBS Phase IV, MBBS interns, BDS interns) were retained in the analytic sample on the basis that they had provided consent and completed the questionnaire in full; no participant who provided consent and complete outcome data was excluded on the basis of year of study.

Outcome measure: the Oxford Happiness Questionnaire

Happiness was measured using the Oxford Happiness Questionnaire (OHQ-29), a 29-item self-report instrument in which each item is rated on a 6-point scale (1 = strongly disagree to 6 = strongly agree) [16]. Twelve items (1, 5, 6, 10, 13, 14, 19, 23, 24, 27, 28, and 29) are negatively worded and were reverse-coded prior to scoring, in accordance with the original scoring procedure for the instrument. The OHQ-29 total score was calculated as the sum of the 29 item scores, yielding a theoretical range of 29 to 174, a

mean item score was also calculated, yielding a theoretical range of 1 to 6. Internal consistency of the 29-item scale was assessed using Cronbach's alpha.

Other study variables

Sociodemographic data collected included age, gender, course of study, current residence, family type, and parental marital status. Anthropometric data were used to calculate body mass index (BMI) as weight in kilograms divided by the square of height in metres, categorized according to the Asia-Pacific classification for BMI. Lifestyle variables included physical activity, extracurricular participation, tobacco use, alcohol use, and recreational drug use in the preceding 12 months, sleep duration and sleep quality, and social-media use. Psychosocial variables included relationship with family, friends-circle size, peer-relationship quality, and satisfaction with recent examination performance.

The extent of missing data for each variable is reported in the supplementary file. BMI had the highest proportion of missing data (124/496, 25.0%); as this missingness was not associated with the outcome but was associated with course of study and social-media hours, it was treated as missing at random conditional on observed covariates. On this basis, the primary multivariable model was estimated using complete-case analysis, and two additional approaches were carried out as pre-specified sensitivity analyses: (i) a model excluding BMI from the covariate set, which recovered a larger analytic sample (N = 407), and (ii) multiple imputation by chained equations (20 imputed datasets; BMI imputed from age, sleep duration, social-media hours, OHQ-29 total score, course, gender, and residence; estimates combined using Rubin's rules). Missingness in other covariates (each ≤ 8.7%) was handled by complete-case analysis in the primary model, given the lower proportion of missing data and the absence of an identified informative missingness pattern for these variables.

Statistical analysis

All analyses were conducted in Python (version 3.12) using pandas and NumPy for data management, SciPy for bivariate hypothesis tests, statsmodels for regression modelling and model diagnostics, pingouin for internal-consistency analysis, and scikit-learn for multiple imputation.

Descriptive statistics are reported as mean ± standard deviation and median (interquartile range) for continuous variables, and as frequency (percentage) for categorical variables, with the number and percentage of missing observations reported for each variable.

Bivariate associations between candidate determinants and OHQ-29 total score were assessed using one-way analysis of variance (ANOVA) with eta-squared (η^2) as the effect-size measure for categorical predictors with more than two levels, independent-samples t-tests (Welch) with Cohen's d for binary predictors, and Pearson correlation coefficients (r, with r^2 as the corresponding effect size) for continuous predictors. For binary predictors, the test statistic was computed as the difference between

the “no” and “yes” groups, a negative t statistic therefore indicates higher OHQ-29 scores among participants reporting the exposure.

The primary analysis was a multiple linear regression of OHQ-29 total score on 19 pre-specified covariates. Categorical covariates were entered as indicator (dummy) variables against an explicit reference category: gender (reference: female), course (reference: BDS), current residence (reference: own house), relationship with family (reference: excellent), family type (reference: nuclear), parental marital status (reference: living together), tobacco use, alcohol use, recreational drug use, physical activity, and extracurricular participation (each reference: no), sleep quality (reference: excellent), friends-circle size (reference: small), peer-relationship quality (reference: fair/poor), and academic satisfaction (reference: dissatisfied). Unstandardized regression coefficients (β) with 95% confidence intervals and standardized regression coefficients are reported for each term.

Model assumptions were assessed using the variance inflation factor (collinearity), the Breusch-Pagan test (homoscedasticity), the Ramsey regression equation specification error test (functional-form misspecification), the Shapiro-Wilk test together with skewness and excess kurtosis (residual normality), and Cook’s distance and leverage statistics (influential observations). Because residuals departed from normality, the primary model was re-estimated using Huber-weighted robust regression as a corroborating analysis; ordinary least squares point estimates are unbiased under non-normal residuals, with non-normality primarily affecting the precision of inferential statistics.

The relative importance of each predictor was quantified using a drop-one unique-variance method, defined as the reduction in model R^2 on removal of each predictor from the full model.

Four interactions were specified prior to analysis on conceptual grounds: course-by-sleep-quality, gender-by-sleep-quality, gender-by-physical-activity, and course-by-academic-satisfaction. Each was tested by comparing, via F-test, a model including the interaction terms with the corresponding main-effects-only model, with the change in adjusted R^2 (ΔR^2adj) reported alongside the F-test p-value.

Three sensitivity analyses were conducted: (i) Huber-weighted robust regression on the complete-case sample, (ii) the BMI-excluded model, and (iii) the multiple-imputation model, each described above. A determinant was considered stable if it retained statistical significance ($p < 0.05$) and a consistent direction of association across the primary model and all three sensitivity analyses. For all analyses, a two-sided p-value < 0.05 was considered statistically significant.

Results

Participant characteristics & Flow

Of 526 questionnaires submitted, 30 (5.7%) were excluded because consent had been declined or left blank, leaving 496 participants in the analytic sample. All 496 participants provided complete responses to all 29 items of the Oxford Happiness Questionnaire (OHQ-29). The primary multivariable model was

estimated on a complete-case subset of 312 participants with non-missing data on all 19 candidate covariates.

Mean age was 21.2 ± 1.4 years (median 21.0, IQR 20.0–22.0); age was missing for 33 participants (6.7%). The sample comprised 318 women (64.1%) and 174 men (35.1%), with gender unrecorded for 4 participants (0.8%). A total of 282 participants (56.9%) were enrolled in the undergraduate medical (MBBS) programme and 214 (43.1%) in the dental (BDS) programme. Most participants resided in a hostel or paying-guest accommodation (312, 62.9%), followed by an own house (102, 20.6%) and a rented room or house (77, 15.5%); residence was missing for 5 participants (1.0%). Most participants belonged to a nuclear family (416, 83.9% versus 78, 15.7% joint family; missing 2, 0.4%) and reported that their parents were living together (469, 94.6% versus 21, 4.2% not living together; missing 6, 1.2%). Relationship with family was rated excellent by 315 participants (63.5%), good by 137 (27.6%), and fair or poor by 41 (8.3%); this item was missing for 3 participants (0.6%). Full participant characteristics are presented in Table 1.

Table 1
Sociodemographic characteristics of participants (N = 496)

	Characteristic	n (%)
Age (years)	Mean ± SD	21.2 ± 1.4
	Median (IQR)	21.0 (20.0–22.0)
	Missing	33 (6.7)
Gender	Female	318 (64.1)
	Male	174 (35.1)
	Missing	4 (0.8)
Course	MBBS	282 (56.9)
	BDS	214 (43.1)
Current residence	Own house	102 (20.6)
	Rented	77 (15.5)
	Hostel/PG	312 (62.9)
	Missing	5 (1.0)
Family type	Nuclear	416 (83.9)
	Joint	78 (15.7)
	Missing	2 (0.4)
Parents marital status	Living together	469 (94.6)
	Not together	21 (4.2)
	Missing	6 (1.2)
Relationship with family	Excellent	315 (63.5)
	Good	137 (27.6)
	Fair/Poor	41 (8.3)
	Missing	3 (0.6)

(Percentages are calculated on the full analytic sample (N = 496) and include missing observations)

Mean BMI was 23.1 ± 4.1 kg/m² (median 22.7, IQR 20.3–24.9); BMI was missing for 124 participants (25.0%). By Asia-Pacific classification, 159 participants (32.1%) had a normal BMI, 78 (15.7%) were

overweight, 69 (13.9%) met criteria for obesity class I, 23 (4.6%) for obesity class II, and 43 (8.7%) were underweight. Most participants reported engaging in physical activity (366, 73.8%) and extracurricular activity (359, 72.4%). Tobacco use in the preceding 12 months was reported by 57 participants (11.5%), alcohol use by 139 (28.0%), and recreational drug use by 53 (10.7%). Mean sleep duration was 6.7 ± 1.1 hours per night (median 7.0, IQR 6.0–7.0; missing 24, 4.8%), and sleep quality was rated excellent by 123 participants (24.8%), good by 234 (47.2%), fair by 95 (19.2%), and poor or very poor by 37 (7.5%); missing for 7 participants (1.4%). Mean social-media use was 2.7 ± 2.0 hours per day (missing 43, 8.7%). Friends-circle size was small for 227 participants (45.8%), moderate for 201 (40.5%), and large for 57 (11.5%); missing for 11 (2.2%). Peer relationship quality was rated excellent or outstanding by 156 participants (31.5%), good by 216 (43.5%), and fair or poor by 115 (23.2%); missing for 9 (1.8%). Satisfaction with recent examination performance was reported as satisfied by 161 participants (32.5%), neutral by 235 (47.4%), and dissatisfied by 89 (17.9%); missing for 11 (2.2%). Lifestyle and psychosocial characteristics in full are presented in Table 2.

Table 2
Anthropometric, lifestyle, and psychosocial characteristics of participants (N = 496)

Characteristic		**n (%)**
BMI (kg/m²)	Mean ± SD	23.1 ± 4.1
	Median (IQR)	22.7 (20.3–24.9)
	Missing	124 (25.0)
BMI category (Asia-Pacific)	Underweight	43 (8.7)
	Normal	159 (32.1)
	Overweight	78 (15.7)
	Obese I	69 (13.9)
	Obese II	23 (4.6)
	Missing	124 (25.0)
Any physical activity	Yes	366 (73.8)
	No	130 (26.2)
	Missing	0 (0.0)
Extracurricular activity	Yes	359 (72.4)
	No	134 (27.0)
	Missing	3 (0.6)
Tobacco use (past 12 mo)	Yes	57 (11.5)
	No	437 (88.1)
	Missing	2 (0.4)
Alcohol use (past 12 mo)	Yes	139 (28.0)
	No	354 (71.4)
	Missing	3 (0.6)
Recreational drug use	Yes	53 (10.7)
	No	443 (89.3)
	Missing	0 (0.0)
Sleep duration (h/night)	Mean ± SD	6.7 ± 1.1
	Median (IQR)	7.0 (6.0–7.0)

Characteristic		n (%)
	Missing	24 (4.8)
Sleep quality	Excellent	123 (24.8)
	Good	234 (47.2)
	Fair	95 (19.2)
	Poor/VeryPoor	37 (7.5)
	Missing	7 (1.4)
Social-media use (h/day)	Mean ± SD	2.7 ± 2.0
	Median (IQR)	2.0 (1.0–4.0)
	Missing	43 (8.7)
Friends-circle size	Small	227 (45.8)
	Moderate	201 (40.5)
	Large	57 (11.5)
	Missing	11 (2.2)
Peer relationship	Excellent/Outstanding	156 (31.5)
	Good	216 (43.5)
	Fair/Poor	115 (23.2)
	Missing	9 (1.8)
Academic satisfaction	Satisfied	161 (32.5)
	Neutral	235 (47.4)
	Dissatisfied	89 (17.9)
	Missing	11 (2.2)

OHQ-29 scoring and reliability

The OHQ-29 was scored after reverse-coding items 1, 5, 6, 10, 13, 14, 19, 23, 24, 27, 28, and 29, in accordance with the original scoring procedure for the instrument. The mean OHQ-29 total score was 111.5 ± 20.7 (median 111, IQR 99–125; observed range 41–166; theoretical range 29–174), corresponding to a mean item score of 3.84 ± 0.71 on the 1–6 response scale. Internal consistency was high (Cronbach's α = 0.894, 95% CI 0.88–0.91). The corrected item-total correlation for item 2 ("I am intensely interested in other people") fell below 0.20; corrected item-total correlations for the remaining

28 items ranged from 0.20 to 0.71.(Table 3). The distribution of OHQ-29 total scores is presented in Fig. 1.

Bivariate analyses

In unadjusted analyses (Table 4), OHQ-29 total scores differed by sleep quality (one-way ANOVA, $F = 35.70$, $\eta^2 = 0.181$, $p < 0.001$), relationship with family ($F = 33.61$, $\eta^2 = 0.121$, $p < 0.001$), peer relationship ($F = 25.77$, $\eta^2 = 0.096$, $p < 0.001$), friends-circle size ($F = 15.07$, $\eta^2 = 0.059$, $p < 0.001$), academic satisfaction ($F = 13.23$, $\eta^2 = 0.052$, $p < 0.001$), and current residence ($F = 5.39$, $\eta^2 = 0.022$, $p = 0.005$). OHQ-29 total scores were higher among participants who reported extracurricular participation (113.6 versus 105.8; $t = -3.93$, Cohen's $d = -0.38$, $p < 0.001$) and physical activity (112.8 versus 107.6; $t = -2.53$, $d = -0.25$, $p = 0.012$), and lower among participants who reported alcohol use (104.6 versus 114.2; $t = 4.74$, $d = 0.47$, $p < 0.001$) and tobacco use (103.7 versus 112.4; $t = 2.85$, $d = 0.42$, $p = 0.006$). Weak inverse correlations were observed between OHQ-29 total score and social-media hours ($r = -0.122$, $r^2 = 0.015$, $p = 0.010$) and age ($r = -0.114$, $r^2 = 0.013$, $p = 0.014$). No association with OHQ-29 total score was observed for recreational drug use ($t = 1.70$, $d = 0.28$, $p = 0.094$), sleep duration ($r = 0.029$, $p = 0.528$), parental marital status ($t = 0.42$, $p = 0.681$), course ($t = -0.30$, $p = 0.762$), BMI as a continuous measure ($r = -0.015$, $p = 0.771$) or as a categorical variable ($F = 0.21$, $\eta^2 = 0.002$, $p = 0.931$), family type ($t = 0.25$, $p = 0.801$), or gender ($t = 0.05$, $p = 0.963$).

Table 3
Unadjusted associations between candidate determinants and OHQ-29 total score.

Variable	Test	Statistic	Effect size	p	Direction	n
Sleep quality	ANOVA	F = 35.70	η^2=0.181	< 0.001	Higher with better sleep quality	489
Relationship with family	ANOVA	F = 33.61	η^2=0.121	< 0.001	Higher with better family relationship	493
Peer relationship	ANOVA	F = 25.77	η^2=0.096	< 0.001	Higher with better peer relationship	487
Friends-circle size	ANOVA	F = 15.07	η^2=0.059	< 0.001	Higher with larger friends circle	485
Academic satisfaction	ANOVA	F = 13.23	η^2=0.052	< 0.001	Higher with academic satisfaction	485
Alcohol use (past 12 months)	t-test	t = 4.74	d = 0.47	< 0.001	Lower in users	493
Extracurricular participation	t-test	t=-3.93	d=-0.38	< 0.001	Higher in participants	493
Current residence	ANOVA	F = 5.39	η^2=0.022	0.005	Differs by residence	491
Tobacco use (past 12 months)	t-test	t = 2.85	d = 0.42	0.006	Lower in users	494
Social-media use (h/day)	Pearson	r=-0.122	r^2=0.015	0.010	Inverse	453
Physical activity	t-test	t=-2.53	d=-0.25	0.012	Higher in active students	496
Age (years)	Pearson	r=-0.114	r^2=0.013	0.014	Inverse	463
Recreational drug use	t-test	t = 1.70	d = 0.28	0.094	Lower in users (NS)	496
Sleep duration (h/night)	Pearson	r = 0.029	r^2=0.001	0.528	NS	472
Parental marital status	t-test	t = 0.42	d = 0.11	0.681	NS	490
Course	t-test	t=-0.30	d=-0.03	0.762	NS	496
Body mass index (kg/m2)	Pearson	r=-0.015	r^2=0.000	0.771	NS	372
Family type	t-test	t = 0.25	d = 0.03	0.801	NS	494
Body mass index category	ANOVA	F = 0.21	η^2=0.002	0.931	NS	372

Variable	Test	Statistic	Effect size	p	Direction	n
Gender	t-test	t = 0.05	d = 0.00	0.963	NS	492

(NS not statistically significant at p < 0.05. n denotes the number of participants with non-missing data for that variable and the outcome)

Multivariable regression analysis

A multiple linear regression of OHQ-29 total score on 19 pre-specified sociodemographic, lifestyle, and psychosocial covariates was estimated by complete-case analysis (N = 312). Categorical covariates were entered as indicator variables against an explicit reference category (Table 4). The model was statistically significant ($F(26, 285) = 8.49$, $p < 0.001$) and accounted for 43.7% of the variance in OHQ-29 total score ($R^2 = 0.437$; adjusted $R^2 = 0.385$).

After adjustment, lower OHQ-29 scores were associated with poorer sleep quality relative to excellent sleep quality (good: β = -12.0, 95% CI -17.1 to -6.9, p < 0.001; fair: β = -19.7, 95% CI -26.1 to -13.4, p < 0.001; poor/very poor: β = -26.0, 95% CI -34.8 to -17.2, p < 0.001), a fair or poor relationship with family relative to an excellent relationship (β = -9.2, 95% CI -17.1 to -1.4, p = 0.021), recreational drug use (β = -8.0, 95% CI -15.1 to -1.0, p = 0.026), and alcohol use (β = -5.4, 95% CI -10.3 to -0.6, p = 0.028). Higher OHQ-29 scores were associated with extracurricular participation (β = 9.2, 95% CI 4.8 to 13.7, p < 0.001), a large friends circle relative to a small circle (β = 9.4, 95% CI 2.3 to 16.5, p = 0.010; moderate circle: β = 4.5, 95% CI 0.0 to 8.9, p = 0.049), good or excellent/outstanding peer relationship relative to a fair/poor relationship (good: β = 8.2, 95% CI 3.0 to 13.4, p = 0.002; excellent/outstanding: β = 7.2, 95% CI 1.4 to 12.9, p = 0.014), and satisfaction with recent examination performance relative to dissatisfaction (β = 6.7, 95% CI 1.0 to 12.3, p = 0.020). Age, gender, course, BMI, residence, family type, parental marital status, tobacco use, physical activity, sleep duration, and social-media hours were not independently associated with OHQ-29 score in the adjusted model (all p > 0.05). The standardized coefficient for the poor/very poor sleep-quality category exceeded unity in absolute value (standardized β = -1.19). Full regression output, including non-significant terms, is presented in Table 4. Forest plots of the adjusted associations (β with 95% confidence intervals) for all significant determinants are shown in Fig. 2.

Table 4
Multiple linear regression of OHQ-29 total score on 19 sociodemographic, lifestyle, and psychosocial covariates (complete-case analysis, N = 312)

Covariate (reference category)	β	95% CI	Standardized β	p
Sleep quality: Fair	-19.7	-26.1 to -13.4	-0.903	< 0.001
Sleep quality: Poor/very poor	-26.0	-34.8 to -17.2	-1.190	< 0.001
Sleep quality: Good	-12.0	-17.1 to -6.9	-0.551	< 0.001
Extracurricular participation: Yes	9.2	4.8 to 13.7	0.423	< 0.001
Peer relationship: Good	8.2	3.0 to 13.4	0.377	0.002
Friends circle: Large	9.4	2.3 to 16.5	0.432	0.010
Peer relationship: Excellent/outstanding	7.2	1.4 to 12.9	0.328	0.014
Academic satisfaction: Satisfied	6.7	1.0 to 12.3	0.306	0.020
Relationship with family: Fair/poor	-9.2	-17.1 to -1.4	-0.423	0.021
Recreational drug use: Yes	-8.0	-15.1 to -1.0	-0.367	0.026
Alcohol use: Yes	-5.4	-10.3 to -0.6	-0.248	0.028
Friends circle: Moderate	4.5	0.0 to 8.9	0.204	0.049
Relationship with family: Good	-4.4	-8.9 to 0.1	-0.201	0.056
Course: MBBS	-3.0	-7.7 to 1.7	-0.138	0.206
Social-media use (h/day)	-0.7	-1.9 to 0.4	-0.057	0.223
Academic satisfaction: Neutral	3.2	-2.0 to 8.5	0.149	0.225
Sleep duration (h/night)	-1.2	-3.1 to 0.8	-0.057	0.237
Physical activity: Yes	2.3	-2.4 to 7.0	0.106	0.335
Gender: Male	1.5	-3.0 to 6.0	0.069	0.513
Residence: Hostel/paying guest	1.7	-3.7 to 7.1	0.078	0.533
Body mass index (kg/m2)	-0.1	-0.6 to 0.4	-0.022	0.645
Age (years)	-0.4	-2.0 to 1.2	-0.022	0.654
Residence: Rented	-0.8	-8.1 to 6.4	-0.038	0.825
Parents: Not living together	0.4	-9.8 to 10.6	0.019	0.935
Family type: Joint	-0.2	-5.8 to 5.4	-0.008	0.950
Tobacco use: Yes	0.1	-7.1 to 7.3	0.004	0.981

(Model: $F(26, 285) = 8.49$, $p < 0.001$; $R^2 = 0.437$; adjusted $R^2 = 0.385$.

Reference categories: gender, female; course, BDS; current residence, own house; relationship with family, excellent; family type, nuclear; parental marital status, living together; tobacco use, alcohol use, recreational drug use, physical activity, and extracurricular participation, no; sleep quality, excellent; friends-circle size, small; peer relationship, fair/poor; academic satisfaction, dissatisfied. Age, body mass index, sleep duration, and social-media use were entered as continuous variables and their coefficients express the change in OHQ-29 total score per one-unit increase.)

Model diagnostics

The variance inflation factor did not exceed 2.02 for any model term, consistent with the absence of problematic collinearity. The Breusch-Pagan test did not indicate heteroscedasticity ($p = 0.189$). The Ramsey regression equation specification error test did not indicate functional-form misspecification ($p = 0.853$). The Shapiro-Wilk test indicated departure of model residuals from a normal distribution ($p = 0.0012$; skewness − 0.43, excess kurtosis 0.61). The maximum Cook's distance was 0.037, below conventional thresholds for influential observations; 21 of 312 observations exceeded the heuristic cut-off of 4/n, none of which coincided with high leverage. Residual diagnostic plots (residuals-versus-fitted, normal quantile-quantile, scale-location, and leverage-versus-Cook's-distance) are presented in Supplementary Table.

Relative importance analysis

Sleep quality accounted for the largest proportion of explained variance (10.3%), followed by extracurricular participation (3.3%), peer relationship (2.0%), friends-circle size (1.6%), relationship with family (1.4%), academic satisfaction (1.1%), and recreational drug use and alcohol use (each 1.0%). Detailed relative importance values for all covariates are presented in Supplementary file.

Interaction analysis

Four interactions were pre-specified and tested, course-by-sleep-quality, gender-by-sleep-quality, gender-by-physical-activity, and course-by-academic-satisfaction. The course-by-sleep-quality interaction was statistically significant ($\Delta R^2adj = + 0.037$, $p < 0.001$), indicating that the magnitude of the sleep-quality effect differs between MBBS and BDS students; the pattern is illustrated in Fig. 3. The other three interactions were not statistically significant. Full interaction model output is provided in Supplementary file.

Sensitivity analyses

Three pre-specified sensitivity analyses were conducted to assess whether conclusions depended on the handling of missing BMI data: (i) robust regression on the complete-case sample (N = 312), (ii) a model excluding BMI from the covariate set (N = 407), and (iii) multiple imputation by chained equations (N = 407). In all three analyses, the eight main determinants, sleep quality, extracurricular participation,

friends-circle size, peer relationship, family relationship, academic satisfaction, and recreational drug use, retained statistical significance and consistent direction of association. Alcohol use attenuated below conventional significance in the BMI-excluded and multiple-imputation models and was not treated as an established finding. Detailed comparison of coefficients across all models is presented in supplementary file.

Discussion

This cross-sectional study examined modifiable lifestyle and psychosocial correlates of happiness, measured using the Oxford Happiness Questionnaire (OHQ-29), among undergraduate medical and dental students in South India. Sleep quality, extracurricular participation, peer-relationship quality, friends-circle size, relationship with family, academic satisfaction, and recreational drug use were each independently associated with OHQ-29 score after adjustment for sociodemographic and lifestyle covariates, and each retained statistical significance and a consistent direction of association across the primary model and three sensitivity analyses. Alcohol use was associated with lower OHQ-29 score in the primary complete-case model but attenuated to below conventional statistical significance when the analytic sample was expanded to address BMI missingness. Age, gender, course of study, BMI, residence, family type, parental marital status, tobacco use, physical activity, sleep duration, and social-media hours were not independently associated with OHQ-29 score.

Sleep quality

Sleep quality accounted for the largest proportion of explained variance and showed a graded association with OHQ-29 score, with successively lower scores across good, fair, and poor/very poor sleep-quality categories relative to excellent sleep quality. Our findings related to sleep quality were broadly consistent with observations reported among Indian medical students by Kukade et al., in whom sleep-related measures demonstrated a positive relationship with happiness-related outcomes, although different measurement instruments were used [16]. The present findings extend this literature by demonstrating that the association between sleep quality and happiness persisted after adjustment for a broad set of sociodemographic, lifestyle, and psychosocial covariates, and that sleep duration did not show an independent association once sleep quality was accounted for.

Peer relationships and friends-circle size

Better peer-relationship quality and a larger friends circle were each independently associated with higher OHQ-29 score. This finding is consistent with a cross-sectional study of medical students in the Andaman and Nicobar Islands, which used the same instrument and reported that a good relationship with friends increased the adjusted odds of being classified as happy (adjusted odds ratio 3.20, 95% CI 1.64–6.26) [15]. A broader cross-sectional survey of university students reported that social and familial factors, including peer relationships, were associated with happiness [17]. The consistency of this association across multiple analytical approaches, dichotomous logistic regression in prior work versus

continuous linear regression here, strengthens the evidence that peer connectedness independently predicts happiness and is not purely dependent on analytical methodology.

Relationship with family

A fair or poor relationship with family, relative to an excellent relationship, was independently associated with lower OHQ-29 score. This finding aligns with reports from general university-student samples in which familial relationship quality has been identified as a correlate of happiness [17]. Cultural context may be relevant to the comparative size of this association as family relationships have been described as a particularly salient source of social support in South Asian student populations, and the present finding is consistent with, though does not establish, this proposition.

Academic satisfaction

Satisfaction with recent examination performance, relative to dissatisfaction, was independently associated with higher OHQ-29 score. This is consistent with findings from a cross-sectional study of health-discipline students in Geneva, Switzerland, which identified academic satisfaction as a correlate of psychological well-being independent of psychological distress [18]. The present study extends this observation to a South Indian medical and dental student population and to happiness specifically, as distinct from the broader well-being and distress measures used in the Geneva study. It was satisfaction with, rather than the numeric level of, examination performance that was examined here.

Extracurricular participation

Participation in extracurricular activity was independently associated with higher OHQ-29 score in this sample. Few Indian or South Asian studies using the OHQ have examined extracurricular participation specifically as a correlate of happiness in medical or dental student populations, which limits direct comparison within the regional literature. The direction of this association is consistent with the broader literature on social and familial determinants of student happiness, in which extracurricular activity is generally considered a proxy for social engagement outside the academic environment [17].

Recreational drug use

Recreational drug use was independently associated with lower OHQ-29 score. This finding is broadly consistent with a cross-sectional study of second-year MBBS students in India using the same instrument, which reported an association between substance use and happiness classification [9]. The present study did not collect data on the frequency, duration, or specific substances involved beyond a binary ever-use indicator in the past 12 months, which limits the granularity of comparison with studies that examined dose or frequency.

Alcohol use: a separate consideration

Alcohol use warrants separate discussion from the determinants above because its association with OHQ-29 score did not demonstrate the same stability across sensitivity analyses. Alcohol use was

independently associated with lower OHQ-29 score in the primary complete-case model (N = 312) and in a regression on the same sample, but this association attenuated to below conventional statistical significance when the analytic sample was expanded to 407 participants through either exclusion of BMI from the model or multiple imputation of missing BMI values. This study's substance-use measures were limited to a binary 12-month indicator without information on quantity or pattern of use, and prior Indian studies relating substance use to happiness using the OHQ have generally also relied on relatively coarse exposure measures [9]. All models showed the same direction of association for alcohol use. The effect weakened when we included more participants, suggesting the finding depends on our specific sample rather than reflecting a robust determinant of happiness. We therefore treat the alcohol association as preliminary and requiring confirmation in future studies.

Findings without an independent association

Several sociodemographic and lifestyle characteristics that have been reported as correlates of happiness in other student populations, including gender, course of study, age, BMI, and physical activity, did not show an independent association with OHQ-29 score after adjustment in this sample. Some of these characteristics were associated with OHQ-29 score in unadjusted bivariate analysis. This pattern is consistent with confounding, characteristics such as gender and physical activity may be associated with happiness through their correlation with other variables in the model, such as sleep quality or social connectedness, rather than through an independent pathway. Because the present analysis adjusted simultaneously for sleep, psychosocial, and substance-use variables that were not jointly modelled in several prior reports, direct comparison of adjusted and unadjusted findings across studies should be made cautiously. The absence of an independent association does not establish the absence of any relationship between these characteristics and happiness.

The course-by-sleep-quality interaction was statistically significant, indicating that the magnitude of the association between sleep quality and OHQ-29 score differed between MBBS and BDS students in this sample.

Institutional implications

The pattern of findings in this study may be relevant to institution-level approaches to student-wellbeing monitoring. Given the magnitude and consistency of the sleep-quality association observed here, these findings may inform institutional attention to sleep hygiene as a domain for wellbeing monitoring, distinct from sleep duration alone. The consistent association of peer relationships, friends-circle size, and extracurricular participation with OHQ-29 score may similarly be relevant to monitoring frameworks attentive to peer-connectedness. The association of academic satisfaction with OHQ-29 score may inform the domains considered within academic-support monitoring. A wellbeing-monitoring framework incorporating a validated happiness measure alongside these domains could allow institutions to observe these modifiable correlates over time.

Limitations

This cross-sectional study cannot establish temporal sequence or rule out reverse causation and unmeasured confounding; associations should not be interpreted as causal. All measures were self-reported, subject to recall and social-desirability bias, particularly for substance use and academics. BMI missingness (25%) was addressed via sensitivity analyses, though some attenuation was observed for alcohol use. Generalizability is limited to a single South Indian institution. No correction for multiple comparisons was applied; replication in independent samples is needed before individual associations are treated as established.

Conclusions

Among medical and dental students at a South Indian institution, sleep quality, peer relationship, friends-circle size, family relationship, academic satisfaction, extracurricular participation, and recreational drug use were independently associated with happiness, with sleep quality accounting for the largest explained variance. Sociodemographic characteristics showed no independent association. These modifiable factors lie within institutional reach. Being cross-sectional, the findings cannot establish causation but identify candidate domains such as sleep, peer connectedness, academics, and substance use, for wellbeing monitoring and future research.

Abbreviations

ANOVA: analysis of variance

BDS: Bachelor of Dental Surgery

BMI: body mass index

CI: confidence interval

IQR: interquartile range

MAR: missing at random

MBBS: Bachelor of Medicine, Bachelor of Surgery

OHQ-29: Oxford Happiness Questionnaire (29-item)

SD: standard deviation

VIF: variance inflation factor

Declarations

Ethics approval and consent to participate: Ethics approval was obtained before the initiation of data collection from the Institutional Ethics Committee of JSS Medical College, Mysuru, with reference

number JSS/MC/PG/91/2022-23 dated 31st March, 2023. Written informed consent was obtained from all participants before questionnaire completion. The study was conducted in accordance with the Declaration of Helsinki and all applicable institutional guidelines.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and/or analysed during the current study are not publicly available because the informed consent obtained from participants did not cover public data release, but are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions:

Rinishnath A: Conceptualisation, methodology, data collection, data curation, formal analysis, literature review, and writing – original draft.
Renuka M: Conceptualisation, methodology, supervision, validation, interpretation of findings, and writing – review and editing.
D. M. Shilpa: Methodology, supervision, validation, interpretation of findings, writing – review and editing, and correspondence with the journal.

All authors critically reviewed and approved the final version of the manuscript and agreed to be accountable for the work.

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Figures

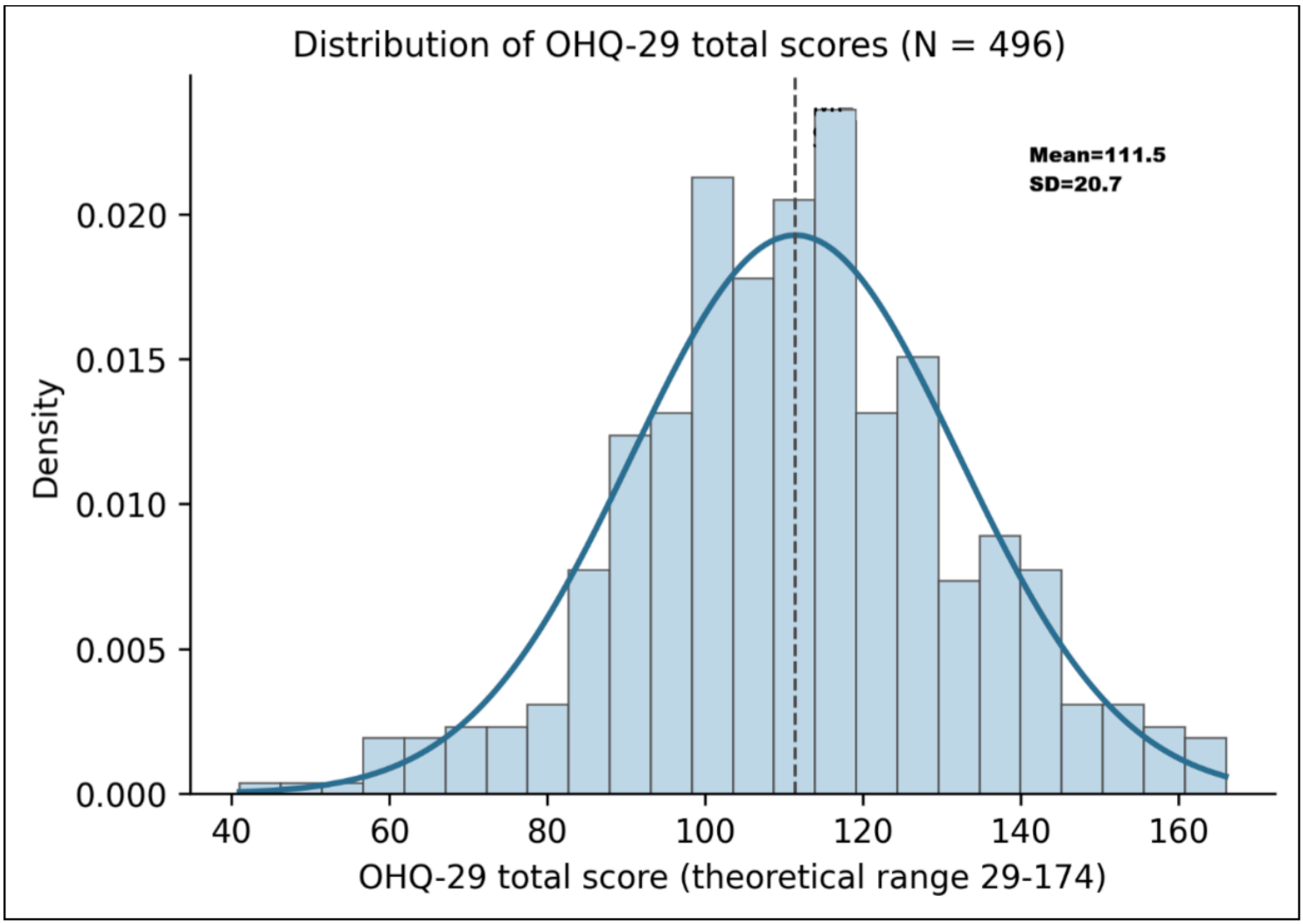


Figure 1

Distribution of Oxford Happiness Questionnaire (OHQ-29) total scores among the analytic sample (N = 496).

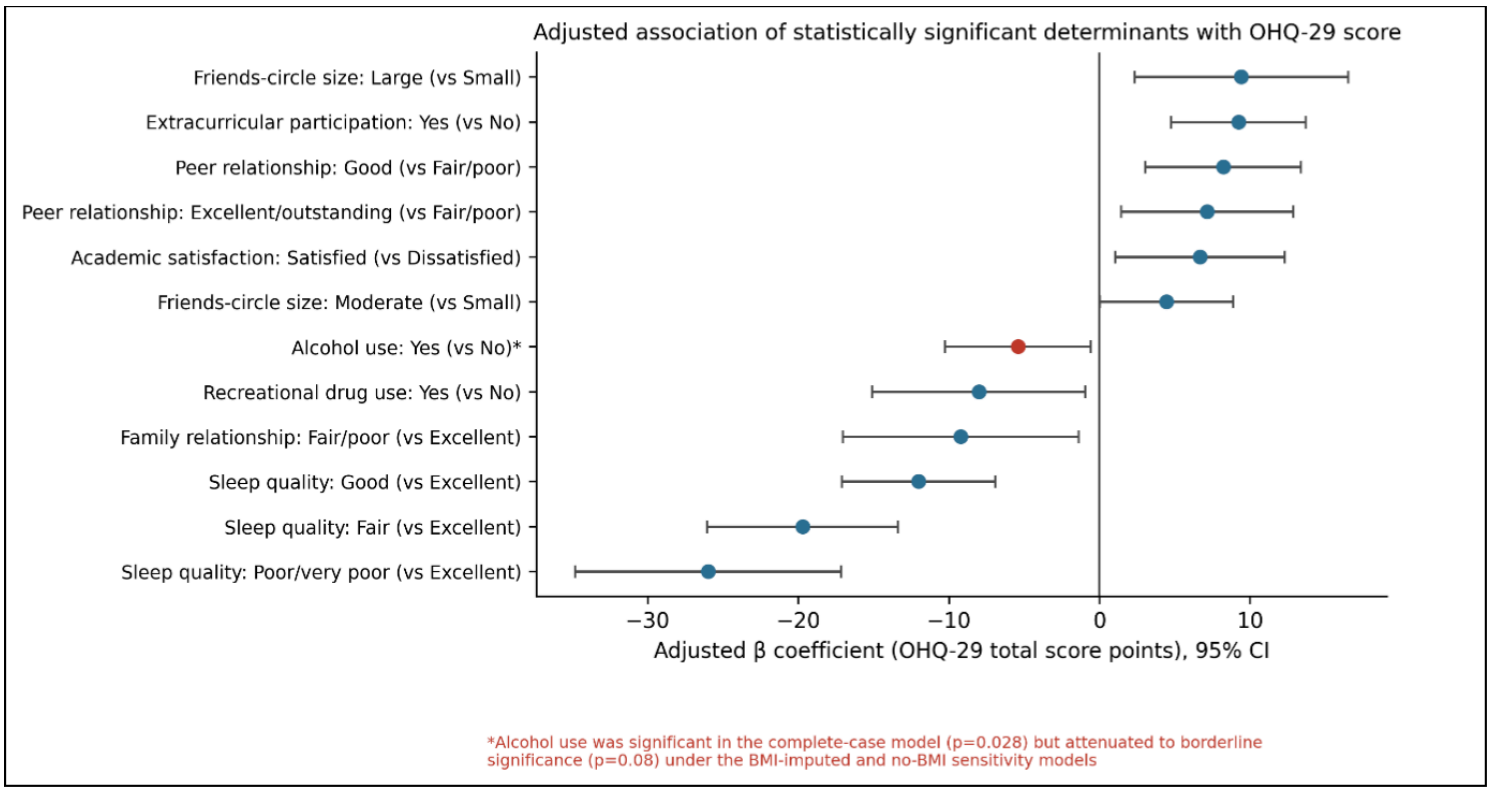


Figure 2

Adjusted associations of statistically significant determinants with OHQ-29 total score (multiple linear regression, complete-case analysis, N = 312)

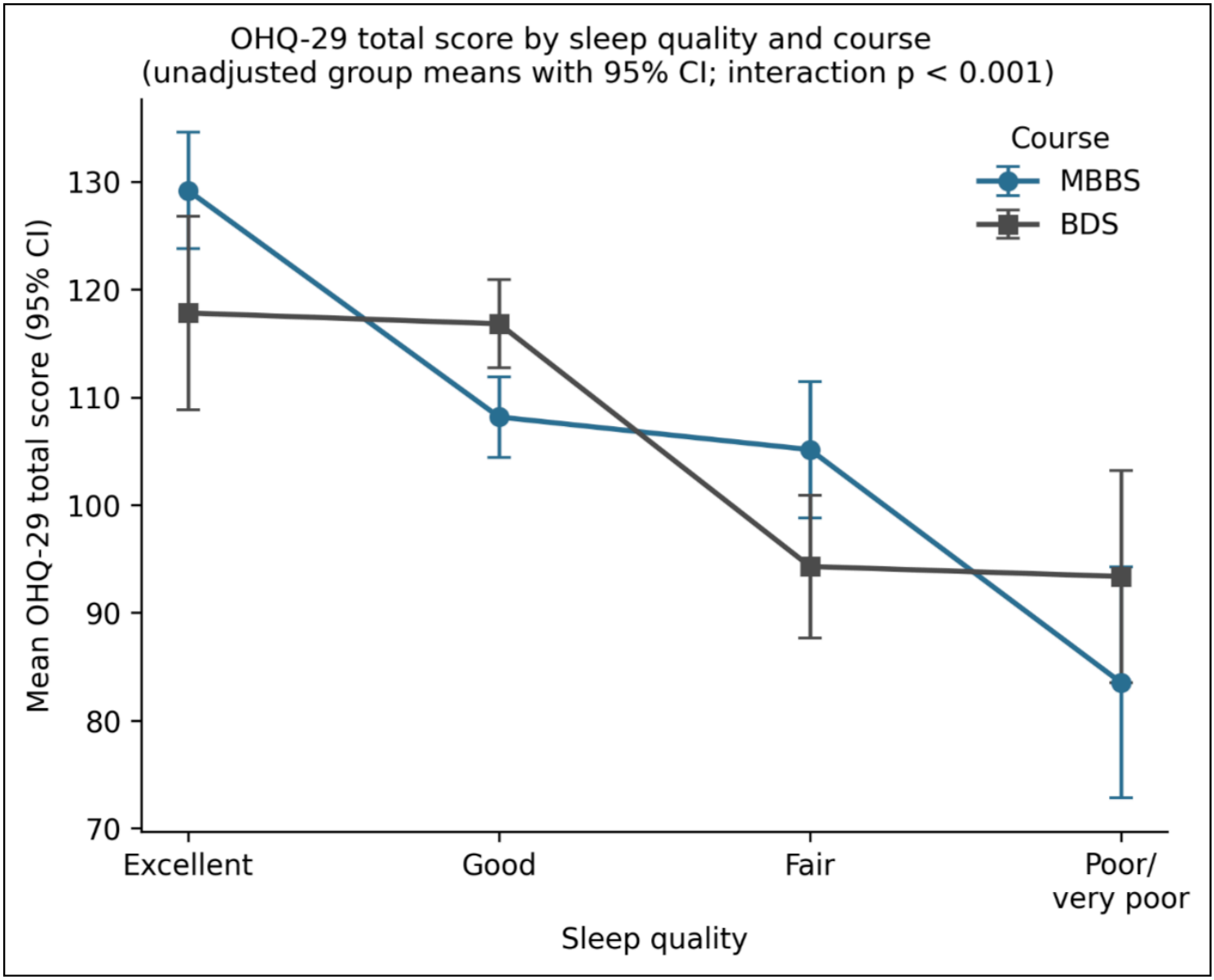


Figure 3

Mean OHQ-29 total score by sleep quality and course of study (medical [MBBS] versus dental [BDS] students)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryMaterial.xlsx