Scholar Journal of Humanities and Social Sciences
Vol. 01, Issue. 04, pp. 47 – 60, Oct – Dec 2026
https://doi.org/10.65219/sjhss.20260104007

SLEEP DURATION, SLEEP QUALITY AND SELF-REPORTED PRODUCTIVITY: A CROSS-SECTIONAL ONLINE SURVEY

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Abstract

Background: Insufficient or poor-quality sleep is widely assumed to impair daily functioning, but it is unclear whether sleep duration or perceived sleep quality is more closely related to everyday productivity outside clinical and laboratory settings. Methods: In a cross-sectional online survey, 349 respondents (students, employed, self-employed and other respondents; 12 aged under 18) reported weekday and weekend sleep duration (four ordered bands), sleep quality (single 1–5 item), daytime tiredness, stress, low motivation and productivity (single 0–10 item). Associations were examined with Spearman correlations, Kruskal–Wallis and Jonckheere–Terpstra tests, and multiple linear regression adjusted for age, gender, occupation and work/study hours, with residual diagnostics and sensitivity analyses. Results: Mean productivity was 6.31 (SD 2.43). Sleep quality was moderately correlated with productivity ($\rho = 0.40$, 95% CI 0.30–0.50) and remained a strong independent correlate in the adjusted model (B = 0.89, 95% CI 0.70–1.09; adjusted $R^2 = 0.21$). Sleep duration showed a negligible association (weekday $\rho = 0.12$, weekend $\rho = 0.11$; about 1% of shared variance) that was not significant after adjustment. Daytime tiredness showed a small, non-monotonic inverse association ($\rho = -0.12$). Conclusions: In this convenience sample, perceived sleep quality, rather than reported sleep duration, was the main correlate of self-rated productivity. Single-item self-reports, common-method variance and possible reverse causality limit inference, and the findings should be replicated with validated instruments and longitudinal designs.

Keywords:

Sleep Duration; Sleep Quality; Productivity; Daytime Tiredness; Cross-Sectional Study; Self-Report

1. Introduction

Sleep supports attention, memory, emotional regulation and executive function, and experimental work shows that restricting sleep degrades cognitive performance. Meta-analyses of sleep-deprivation studies report reliable deficits in attention, vigilance and speed of response (Pilcher & Huffcutt, 1996; Lim & Dinges, 2010), and chronic partial restriction produces cumulative neurobehavioural deficits that participants tend not to recognise (Van Dongen et al., 2003). Outside the laboratory, insomnia has been linked to lower job performance and substantial lost productive time among workers (Kessler et al., 2011), and sleep problems, irregular sleep timing and shorter sleep have been associated with poorer academic performance among students (Gaultney, 2010; Phillips et al., 2017; Okano et al., 2019; for younger samples, Dewald et al., 2010).

Two features of this literature motivate the present study. First, "sleep" is not one construct. Consensus guidance emphasises duration, with adults recommended to obtain at least seven hours per night (Watson et al., 2015; Hirshkowitz et al., 2015), yet instruments such as the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989; Mollayeva et al., 2016) treat duration as only one component alongside latency, disturbance and perceived quality. Two people sleeping the same number of hours may therefore differ substantially in how rested they feel. Second, productivity is usually studied in clinical, laboratory or single-institution samples;

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far less is known about how duration and perceived quality relate to everyday self-rated productivity in mixed community samples of students and workers.

Behaviours such as evening caffeine and pre-sleep screen use are commonly proposed as modifiable influences on sleep (Drake et al., 2013; Chang et al., 2015). We therefore recorded these behaviours and examined them descriptively, but the study was not designed to test them as causes of poor sleep or low productivity.

1.1 Objectives and Hypotheses

The objectives were to (1) describe sleep duration, sleep quality and productivity in the sample; (2) estimate the association between sleep duration and self-reported productivity; (3) estimate the association between sleep quality and productivity; (4) examine the associations of daytime tiredness, stress and low motivation with productivity; and (5) determine whether sleep quality remains associated with productivity after adjustment for sleep duration, wellbeing, screen time and demographic and work characteristics. The hypotheses were:

- **H1:** Longer sleep duration is positively associated with self-reported productivity.
- **H2:** Higher sleep quality is positively associated with self-reported productivity.
- **H3:** More frequent daytime tiredness is associated with lower self-reported productivity (a monotonic, inverse trend).
- **H4:** Sleep quality is independently associated with productivity after adjustment for sleep duration, tiredness, stress, non-work screen time, age, gender, occupation and weekday work/study hours.
- **Exploratory:** Higher stress and low motivation are associated with lower productivity.

2. Methods

2.1 Design and Reporting

This was a cross-sectional, correlational online survey, reported in accordance with the STROBE statement for cross-sectional studies (von Elm et al., 2007).

2.2 Participants, Recruitment and Consent

Respondents were students and working adults aged ≥ 60 years] recruited through WhatsApp groups, social media, college and workplace contacts; in Chennai between August (2026) and September (2026. The questionnaire was self-administered online from Google survey and participation was voluntary and anonymous and no identifying information was collected. Electronic informed consent was obtained before the questionnaire was displayed "the following responses will be monitored". A total of 349 complete responses were received; there were no missing values on the items analysed except for the invalid response option to one item described in Section 2.4.

Twelve respondents (3.4%) were aged under 18 years. For minors, consent requires presence of legal guardian. Because the validity of these responses depends on that procedure, all primary analyses were repeated without them (Section 3.5).

2.3 Measures

The questionnaire comprised 32 items. The variables analysed here were as follows.

- **Sleep Duration.** Average weekday and weekend sleep were each reported in one of four ordered bands: "less than 5 hours", "5–6 hours", "6–7 hours" and "more than 7 hours". The labels of adjacent bands share their end-points (6 h and 7 h), so a respondent sleeping exactly 6 h could legitimately select either of two bands, and a respondent sleeping exactly 7 h could not select "more than 7 hours". We therefore treated the bands strictly as ordered categories (scored 1–4 where a trend was needed) and did not convert them to exact hours in the primary analyses. Because respondents sleeping exactly 7 h fall in the 6–7 h band, the data cannot show how many met the ≥ 7 h recommendation. Sensitivity analyses recoded the bands to midpoints (4.5, 5.5, 6.5 h) with the open-ended top band set to 8 h or 9 h, and also entered duration as dummy-coded categories (Section 3.5).
- **Sleep Quality.** One item ("How do you rate your sleep quality?"), answered 1–5, with higher values indicating better quality (verbal anchors for the scale points were not recorded). This is a single-item global rating. It is conceptually similar to the global sleep-quality item of the PSQI and to single-item numeric sleep-quality scales that have shown acceptable reliability and validity in clinical samples

(Cappelleri et al., 2009; Snyder et al., 2018), but it was not itself validated in this population.

- **Productivity.** One item rating daily productivity from 0 to 10 (observed range 1–10). Single-item self-ratings of overall performance on a 0–10 scale are used in the WHO Health and Work Performance Questionnaire (Kessler et al., 2003), but the present wording has not been validated against objective output. A second item on task completion was invalid for most respondents and was not used as an outcome (Section 2.4).
- **Daytime tiredness** (never, occasionally, most days, always), stress (never, rarely, sometimes, often) and low or unmotivated mood (never, occasionally, frequently, almost daily) were each single frequency items scored 0–3. Non-work screen time was reported in four bands (< 2, 2–4, 4–6, > 6 h; scored 0–3).
- **Covariates:** age group (< 18, 18–24, 25–34, 35–44, ≥ 45 years), gender, occupation (working professional, student, self-employed, unemployed, other) and average weekday work/study hours (< 4, 4–6, 6–8, > 8 h).
- **Behaviours examined descriptively:** caffeine after 6 PM, daily caffeine cups, phone/laptop use before sleep, sleep-schedule consistency and exercise frequency.

The PSQI (Buysse et al., 1989), the Insomnia Severity Index (ISI; Bastien et al., 2001) and the Epworth Sleepiness Scale (ESS; Johns, 1991) are the standard validated instruments for sleep quality, insomnia symptoms and daytime sleepiness, respectively. They were not administered. The use of brief single-item measures, chosen to reduce respondent burden in an anonymous online survey, is a principal limitation (Section 4.3) and the main reason the results should be read as exploratory.

2.4 Data Handling and Instrument Error

Item 21 ("How often do you complete your planned tasks for the day?") was intended to use a frequency response scale, but its option list contained the response "Improved", which is not a valid answer to a frequency question. This option was selected by 110 of 349 respondents (31.5%). Because its meaning is uninterpretable, these answers were set to missing for this item (not recoded into another category and not imputed); the remaining 239 responses ("almost always", "sometimes", "rarely") were retained. The item was excluded from all primary analyses and used only for a descriptive convergent-validity check of the productivity item. Respondents with an invalid answer to Item 21 were retained in every other analysis. We cannot rule out that those 110 respondents differ systematically from the rest, and the error is listed as a limitation. A corrected version of the item is given in Appendix A.

2.5 Statistical Analysis

Categorical variables are summarised as counts and percentages and productivity as mean, standard deviation and median. Because sleep duration, tiredness, stress and motivation are ordinal, bivariate associations with productivity were estimated with Spearman's ρ (95% confidence intervals from 2,000 bootstrap resamples), and group differences were tested with the Kruskal–Wallis test (Kruskal & Wallis, 1952; effect size ε^2), the Jonckheere–Terpstra test for an ordered trend and Dunn's pairwise comparisons with Holm correction. Effect sizes were interpreted with Cohen's (1988) benchmarks ($|\rho| \approx .10$ small, .30 medium, .50 large), and ρ^2 is reported as shared rank variance. With 349 respondents the study had 80% power to detect $|\rho| \approx .15$ (two-sided $\alpha = .05$); smaller associations could not be reliably detected.

The primary model was an ordinary least squares regression of productivity on weekday sleep duration, weekend sleep duration, sleep quality, daytime tiredness, stress and screen time (all entered as ordinal scores), adjusted for age group, gender (female, male, other/not stated), occupation and weekday work/study hours (dummy-coded). Models were built hierarchically (Model 1: sleep quality; Model 2: plus sleep duration, tiredness, stress and screen time; Model 3: plus demographic and work covariates), and Model 3 is reported in full with unstandardised coefficients (B), standard errors, standardised coefficients (β), 95% confidence intervals, t and p values, variance inflation factors (VIF), and the overall F test. Because weekday and weekend duration are correlated, we report their correlation and VIFs and repeated the analysis with their mean and with weekday duration alone. Departures from linearity of each ordinal predictor were tested by comparing the model with a

dummy-coded version of that predictor. Residual assumptions were checked with a normal Q–Q plot and the Shapiro–Wilk test (normality), a residual-versus-fitted plot and the Breusch–Pagan test (homoscedasticity), and Cook's distance (influence); HC3 heteroscedasticity-robust standard errors and an ordered-logit model of the 1–10 rating were used as robustness checks.

Tests of the hypotheses were two-sided at $\alpha = .05$. For exploratory analyses (Section 3.6), p values were adjusted with the Holm method. Analyses were run in Python 3 (SciPy 1.18, statsmodels 0.15).

3. Results

3.1 Sample Characteristics

Table No 1: Characteristics of the Respondents (N = 349)

Characteristic	n	%
Age group (years)		
< 18	12	3.4
18–24	100	28.7
25–34	124	35.5
35–44	93	26.6
≥ 45	20	5.7
Gender		
Female	182	52.1
Male	163	46.7
Other	2	0.6
Prefer not to say	2	0.6
Occupation		
Working professional	181	51.9
Student	79	22.6
Self-employed	41	11.7
Unemployed	7	2.0
Other	41	11.7
Work/study hours per weekday		
Less than 4 hours	41	11.7
4–6 hours	40	11.5
6–8 hours	87	24.9
More than 8 hours	181	51.9
Work/study mode		
Work/study from office/college	269	77.1
Hybrid (both online and offline)	66	18.9
Work from home	14	4.0

Note: *Percentages are of all respondents; each block sums to 349 (100%). "Other" occupation (n = 41) was not further specified in the questionnaire.*

Source: *Author's calculation based on survey data (N = 349).*

The sample comprised 349 respondents (Table 1): 182 women (52.1%), 163 men (46.7%), two respondents who selected "other" and two who preferred not to state their gender (together 1.1%). Working professionals made up 51.9% and students 22.6%; 41 respondents (11.7%) selected "other" occupation and 7 (2.0%) were unemployed. Most respondents (n = 317) were aged 18–44 years and 51.9% worked or studied more than eight hours per weekday. Age and occupation were strongly related (for example, 68 of 100 respondents aged 18–24 were students), which is why both were retained as covariates.

3.2 Sleep, Wellbeing and Productivity

Productivity was moderately high (M = 6.31, SD = 2.43, median = 7; modal rating 8, n = 67). The

most frequent weekday sleep category was 6–7 h (169 respondents, 48.4%), and 111 respondents (31.8%) reported under six hours on weekdays, compared with 72 (20.6%) at weekends. Sleep quality averaged 3.38 (SD 1.24); 76 respondents (21.8%) rated it 1 or 2. Weekday and weekend duration were moderately correlated (ρ = 0.40).

Table No 2: Self-Reported Productivity (0–10) By Sleep Duration and Sleep Quality

Category	n	Mean	SD	Median
Weekday sleep duration				
<5 h	27	5.22	2.74	5.0
5–6 h	84	6.37	2.21	7.0
6–7 h	169	6.31	2.34	7.0
>7 h	69	6.68	2.67	7.0
Weekend sleep duration				
<5 h	30	6.27	2.99	6.5
5–6 h	42	5.69	2.82	5.5
6–7 h	130	6.10	2.29	6.0
>7 h	147	6.69	2.25	7.0
Sleep quality (1–5)				
1	40	4.08	2.94	3.5
2	36	5.14	2.44	5.0
3	96	6.01	2.08	6.0
4	106	7.08	1.77	7.5
5	71	7.42	2.24	8.0

Note: *SD = standard deviation.*

Source: *Author's calculation based on survey data (N = 349).*

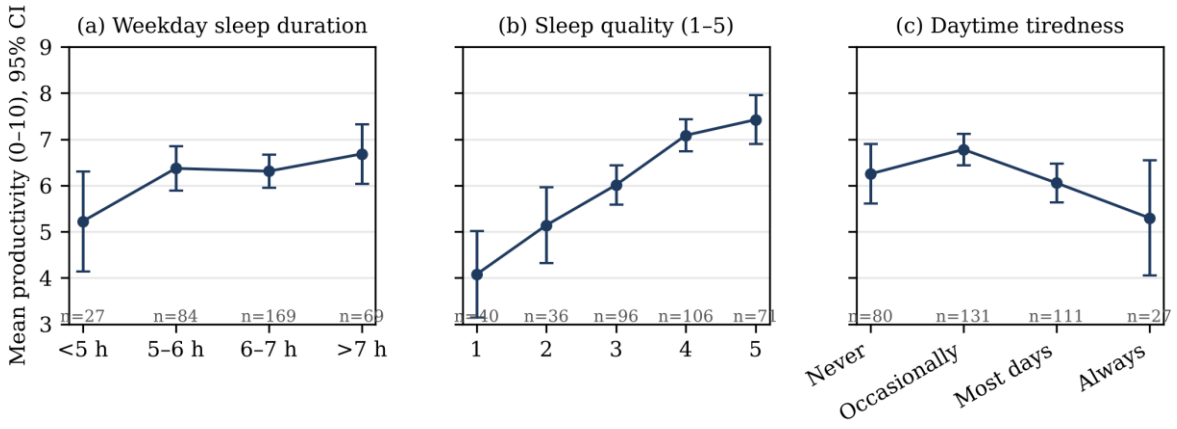


Fig No 1: Mean Self-Reported Productivity With 95% Confidence Intervals By (A) Weekday Sleep Duration, (B) Sleep Quality And (C) Daytime Tiredness.

Source: *Author's calculation based on survey data (N = 349).*

3.3 Bivariate Associations

Table No 3: Associations Between Sleep and Wellbeing Variables and Productivity

Variable	Spearman ρ	95% CI	p	p (Holm)	ρ² (%)	Kruskal–Wallis H (df)	KW p	J–T z (p)
Weekday sleep duration	0.12	0.00 to 0.22	.028	.118	1.4	7.68 (3)	.053	2.24 (.025)

Variable	Spearman ρ	95% CI	p	p (Holm)	ρ² (%)	Kruskal–Wallis H (df)	KW p	J–T z (p)
Weekend sleep duration	0.11	−0.00 to 0.22	.037	.118	1.2	6.62 (3)	.085	2.13 (.033)
Sleep quality (1–5)	0.40	0.30 to 0.50	<.001	<.001	16.3	59.08 (4)	<.001	7.90 (<.001)
Daytime tiredness	−0.12	−0.23 to −0.01	.024	.118	1.5	9.78 (3)	.021	−2.46 (.014)
Stress	−0.11	−0.22 to 0.00	.046	.118	1.1	13.93 (3)	.003	−2.07 (.039)
Low mood/motivation	−0.16	−0.26 to −0.05	.003	.016	2.6	11.68 (3)	.009	−3.14 (.002)
Non-work screen time	−0.07	−0.17 to 0.04	.183	.183	0.5	2.04 (3)	.564	−1.37 (.169)

Note: *ρ = Spearman rank correlation (bootstrap 95% CI); ρ² = shared rank variance; KW = Kruskal–Wallis; J–T = Jonckheere–Terpstra test for an ordered trend (positive z = productivity rises with category). Holm correction applied across the seven correlations.*

Source: *Author's calculation based on survey data (N = 349).*

Sleep Duration (H1). Weekday and weekend sleep duration were positively but only weakly correlated with productivity (ρ = 0.12, p = .028; ρ = 0.11, p = .037). These coefficients correspond to roughly 1% of shared variance, and their bootstrap confidence intervals approach zero (weekday 0.00 to 0.22; weekend −0.00 to 0.22); the association is therefore best described as negligible. The omnibus Kruskal–Wallis test across the four weekday categories was not significant (H = 7.68, p = .053), and the lowest mean (5.22) belonged to the smallest group (< 5 h, n = 27). The two duration variables jointly explained 1.7% of the variance in productivity (F-test p = .053).

Sleep Quality (H2). Sleep quality showed a medium-sized positive association (ρ = 0.40, 95% CI 0.30 to 0.50; p < .001; ρ² = 16%) with a clear graded trend (Jonckheere–Terpstra z = 7.90, p < .001): mean productivity rose from 4.08 at a rating of 1 to 7.42 at a rating of 5 (Table 2, Figure 1b).

3.4 Daytime Tiredness, Stress and Low Motivation (H3 And Exploratory Objectives)

Table No 4: Self-Reported Productivity (0–10) By Frequency of Daytime Tiredness, Stress and Low Motivation

Frequency Category	N	Mean	SD	Median
Daytime tiredness				
Never	80	6.25	2.89	7.0
Occasionally	131	6.78	1.98	7.0
Most days	111	6.05	2.24	6.0
Always	27	5.30	3.15	5.0
Stress				
Never	51	6.37	2.90	7.0
Rarely	76	6.38	2.35	7.0
Sometimes	179	6.55	2.27	7.0
Often	43	5.12	2.29	5.0
Low or unmotivated mood				
Never	121	6.54	2.74	7.0
Occasionally	128	6.58	2.05	7.0
Frequently	64	5.97	2.09	6.0
Almost daily	36	5.22	2.77	5.0

Note: *Each block contains all 349 respondents and includes every response category; groups are ordered from least to most frequent.*

Source: *Author's calculation based on survey data (N = 349).*

Daytime Tiredness (H3). Productivity differed across tiredness categories (Kruskal–Wallis H(3) = 9.78, p = .021, $\varepsilon^2 = 0.020$) and tiredness had a small inverse rank correlation with productivity ($\rho = -0.12$, 95% CI −0.23 to −0.01, p = .024; Jonckheere–Terpstra p = .014). The pattern was not monotonic, however: respondents who were never tired (M = 6.25) scored lower than those who were occasionally tired (M = 6.78), and the declines at "most days" (6.05) and "always" (5.30) were concentrated at the upper end of the scale. No pairwise comparison survived Holm correction; the largest unadjusted differences were occasionally vs. most days (adjusted p = .063) and occasionally vs. always (adjusted p = .080). H3 is therefore only partly supported: the overall trend is inverse and small, but it is not a graded dose–response relationship and it did not remain significant after adjustment (Section 3.5).

Stress and Motivation. Productivity differed by stress (H(3) = 13.93, p = .003), driven by respondents who reported stress "often" (M = 5.12, n = 43), who scored lower than all other groups (Holm-adjusted $p \leq .017$); the other three groups did not differ (M = 6.37–6.55). Productivity also differed by low motivation (H(3) = 11.68, p = .009; $\rho = -0.16$, Holm p = .016); respondents who felt low or unmotivated "almost daily" (M = 5.22, n = 36) scored lower than those who "never" (adjusted p = .019) or "occasionally" (adjusted p = .032) felt that way. Both associations were small ($\rho^2 \approx 1$–3%) and reflect a threshold at the extreme category rather than a gradient across all categories.

3.5 Multiple Regression (H4)

Table No 5: Multiple Linear Regression Predicting Self-Reported Productivity (Model 3; N = 349)

Predictor	B	SE	β	95% CI for B	t	p	VIF
Weekday sleep duration (score 1–4)	0.03	0.16	0.01	−0.28 to 0.35	0.20	.843	1.36
Weekend sleep duration (score 1–4)	0.13	0.14	0.05	−0.15 to 0.40	0.89	.372	1.30
Sleep quality (1–5)	0.89	0.10	0.46	0.70 to 1.09	9.08	<.001	1.12
Daytime tiredness (0–3)	−0.23	0.14	−0.09	−0.51 to 0.05	−1.63	.105	1.22
Stress (0–3)	−0.06	0.15	−0.02	−0.34 to 0.23	−0.40	.692	1.24
Non-work screen time (0–3)	−0.09	0.10	−0.04	−0.29 to 0.12	−0.83	.408	1.07
Age: < 18 years (ref. 25–34 years)	−0.63	0.77	−0.05	−2.14 to 0.88	−0.82	.415	1.48
Age: 18–24 (ref. 25–34 years)	−0.15	0.42	−0.03	−0.99 to 0.68	−0.36	.720	2.78
Age: 35–44 (ref. 25–34 years)	0.27	0.30	0.05	−0.32 to 0.86	0.90	.370	1.32
Age: ≥ 45 years (ref. 25–34 years)	0.87	0.54	0.08	−0.19 to 1.92	1.62	.107	1.17
Gender: male (ref. female)	0.14	0.25	0.03	−0.35 to 0.62	0.55	.581	1.15
Gender: other/not stated (ref. female)	0.23	1.13	0.01	−2.00 to 2.46	0.20	.840	1.10
Occupation: Student (ref. working professional)	−0.36	0.51	−0.06	−1.36 to 0.64	−0.72	.474	3.41

Predictor	B	SE	β	95% CI for B	t	p	VIF
Occupation: Self-employed (ref. working professional)	−0.47	0.39	−0.06	−1.23 to 0.30	−1.20	.230	1.18
Occupation: Unemployed (ref. working professional)	0.38	0.89	0.02	−1.38 to 2.14	0.42	.674	1.19
Occupation: Other (ref. working professional)	−0.36	0.38	−0.05	−1.11 to 0.38	−0.95	.341	1.13
Weekday work/study hours: < 4 h (ref. > 8 h)	−0.69	0.46	−0.09	−1.59 to 0.21	−1.51	.131	1.63
Weekday work/study hours: 4–6 h (ref. > 8 h)	−0.05	0.47	−0.01	−0.97 to 0.87	−0.12	.907	1.67
Weekday work/study hours: 6–8 h (ref. > 8 h)	−0.51	0.30	−0.09	−1.09 to 0.07	−1.72	.086	1.24
Intercept	3.56	0.65	—	2.27 to 4.85	5.44	<.001	—

Note: *$F(19, 329) = 5.97$, $p < .001$; $R^2 = 0.256$, adjusted $R^2 = 0.213$. B = unstandardised coefficient; β = standardised coefficient (B × SD of predictor ÷ SD of productivity; shown for dummy variables for comparison only); VIF = variance inflation factor. ref. = reference category. Ordinal predictors are entered as trend scores; tests of departure from linearity were non-significant for every predictor (all $p > .05$; sleep quality $p = .086$).*

Source: *Author's calculation based on survey data (N = 349).*

In hierarchical models, sleep quality alone explained 19.3% of the variance in productivity (Model 1). Adding sleep duration, tiredness, stress and screen time raised R^2 to 0.215 ($\Delta R^2 = 0.022$, F-change p = .097), and adding demographic and work covariates raised it to 0.256 ($\Delta R^2 = 0.041$, p = .154). In the full model (Table 5) sleep quality was the only significant predictor: each one-point higher rating was associated with 0.89 points higher productivity (95% CI 0.70 to 1.09; β = 0.46; $p < .001$). Neither weekday (B = 0.03, p = .843) nor weekend duration (B = 0.13, p = .372), tiredness (p = .105), stress (p = .692) nor screen time (p = .408) was significant, and no demographic or work covariate was significant. H4 is supported.

Collinearity. Weekday and weekend duration were moderately correlated (ρ = 0.40) but their VIFs were low (1.36 and 1.30); the largest VIF in the model was 3.41 (student occupation, reflecting its overlap with age). Collinearity therefore did not inflate the standard errors materially, although the two duration variables are conceptually overlapping; results were unchanged when they were replaced by their mean or by weekday duration alone (Table 6).

Residual Diagnostics. Residuals were approximately symmetric (skewness = −0.32) but the Shapiro–Wilk test indicated a mild departure from normality (W = 0.989, p = .008), as expected for a bounded integer outcome (Figure 2b; the diagonal bands in Figure 2a arise from the integer ratings). The Breusch–Pagan test did not indicate heteroscedasticity (LM = 27.0, p = .105; Figure 2a), and no observation was influential (maximum Cook's D = 0.044). With N = 349 the coefficients are robust to mild non-normality; HC3-robust standard errors and an ordered-logit model gave the same conclusion (Table 6).

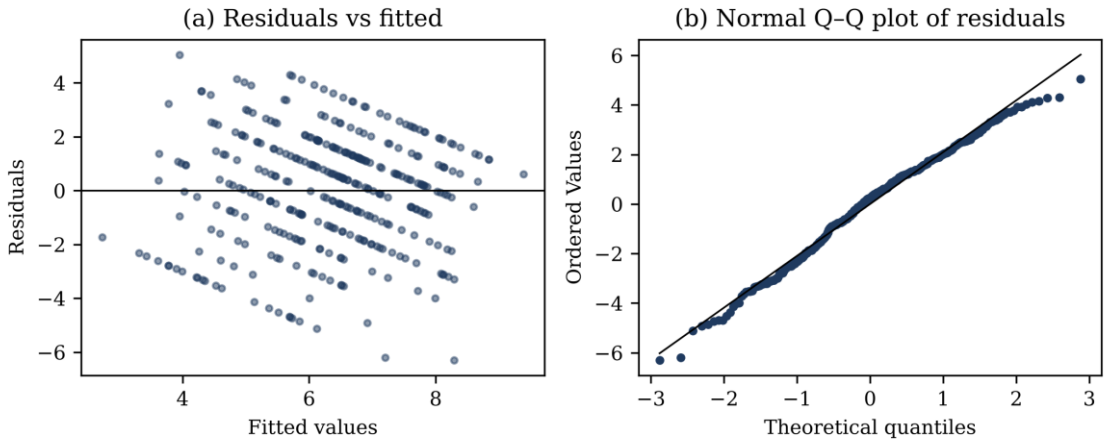


Fig No 2: Residual Diagnostics for Model 3: (A) Residuals Against Fitted Values And (B) Normal Q–Q Plot of Residuals.

Source: *Author's calculation based on survey data (N = 349).*

Table No 6: Sensitivity Analyses: Association of Sleep Quality and Sleep Duration with Productivity

Analysis	N	Adj. R^2	Sleep Quality: B (95% CI)	P	Sleep Duration Term(S): B (P)
Primary model (ordinal duration scores)	349	0.213	0.89 (0.70 to 1.09)	<.001	wkday 0.03 (0.843); wkend 0.13 (0.372)
Mean of weekday and weekend duration score	349	0.215	0.89 (0.70 to 1.09)	<.001	mean 0.17 (0.306)
Weekday duration only	349	0.214	0.90 (0.71 to 1.09)	<.001	wkday 0.09 (0.534)
Midpoint hours, “>7 h” coded 8	349	0.215	0.89 (0.70 to 1.08)	<.001	wkday 0.02 (0.878); wkend 0.13 (0.261)
Midpoint hours, “>7 h” coded 9	349	0.216	0.89 (0.69 to 1.08)	<.001	wkday 0.01 (0.918); wkend 0.11 (0.170)
Duration dummy-coded (reference 6–7 h)	349	0.220	0.87 (0.67 to 1.06)	<.001	block F(6,325)=1.35 (p=0.236)
Excluding respondents <18 years	337	0.219	0.89 (0.69 to 1.08)	<.001	wkday 0.09 (0.585); wkend 0.13 (0.360)
Primary model, HC3-robust standard errors	349	0.213	0.89 (0.66 to 1.12)	<.001	wkday 0.03 (0.861); wkend 0.13 (0.426)
Ordered logit of 1–10 rating (odds ratio)	349	—	OR 2.02 (1.70 to 2.41)	<.001	wkday and wkend: both p > .05

Note: *All models adjust for the covariates in Table 5 (the ordered-logit model adjusts for the other predictors in Model 2 only). Midpoints: < 5 h = 4.5, 5–6 h = 5.5, 6–7 h = 6.5; the top band was set to the value shown. Excluding respondents under 18 removes 12 observations.*

Source: *Author's calculation based on survey data (N = 349).*

Conclusions were unaffected by how sleep duration was coded, by excluding the 12 respondents under 18, or by using robust standard errors. The estimated effect of sleep quality varied only between 0.87 and 0.90, whereas no duration coding produced a significant duration effect. The arbitrary value assigned to the open-ended top band (8 h or 9 h) was therefore immaterial.

3.6 Exploratory Analysis of Behavioral Correlates

Table No 7: Exploratory Spearman Correlations of Lifestyle Behaviors

With Productivity and With Sleep Quality

Behaviour	P With Productivity	P	P (Holm)	P With Sleep Quality	P	P (Holm)
Caffeine after 6 PM	−0.04	.432	1.000	−0.06	.273	1.000
Caffeine, cups/day	0.13	.018	.211	−0.08	.147	1.000
Phone/laptop use before sleep	−0.05	.351	1.000	0.07	.194	1.000
Non-work screen time	−0.07	.183	1.000	0.02	.674	1.000
Sleep-schedule consistency	0.06	.243	1.000	0.12	.023	.228
Exercise frequency	0.12	.020	.220	0.02	.723	1.000

Note: *Holm correction applied across all twelve tests. Behaviours were scored from low to high frequency/amount (see Section 2.3).*

Source: *Author's calculation based on survey data (N = 349).*

None of the examined behaviours was associated with sleep quality or productivity after multiplicity adjustment (all Holm $p \geq .211$). Unadjusted, daily caffeine intake ($\rho = 0.13$, $p = .018$) and exercise frequency ($\rho = 0.12$, $p = .020$) correlated weakly and positively with productivity, and a consistent sleep schedule correlated weakly with sleep quality ($\rho = 0.12$, $p = .023$), but none of these survived correction. Evening caffeine, pre-sleep device use and non-work screen time showed no association ($|\rho| \leq .07$).

3.7 Convergent Check of The Productivity Item

Among the 239 respondents with a valid answer to the task-completion item, productivity was positively correlated with reported frequency of completing planned tasks ($\rho = 0.32$, 95% CI 0.21 to 0.43), which gives modest support for the productivity item, with the caveat that both ratings are self-reports.

3.8 Summary of Hypothesis Tests

Table No 8: Summary of Hypothesis Tests

Hypothesis	Evidence	Decision
H1: Longer sleep duration → higher productivity	Weekday $\rho = 0.12$ ($p = .028$), weekend $\rho = 0.11$ ($p = .037$); $\rho^2 \approx 1\%$; KW (weekday) $p = .053$; adjusted B ns	Statistically significant but negligible; not supported as a meaningful association
H2: Higher sleep quality → higher productivity	$\rho = 0.40$ (95% CI 0.30–0.50); $p < .001$	Supported (medium effect)
H3: More frequent tiredness → lower productivity	$\rho = −0.12$ ($p = .024$); KW $p = .021$; J–T $p = .014$; non-monotonic; no pairwise difference after Holm; adjusted $p = .105$	Partly supported (small, non-monotonic; not independent of other predictors)
H4: Sleep quality independently associated with productivity	B = 0.89 (95% CI 0.70–1.09), $p < .001$; robust to all sensitivity analyses	Supported
Exploratory: stress, low motivation → lower productivity	Stress "often" and low motivation "almost daily" scored lower (Holm-adjusted $p < .05$); $\rho = −0.11$ and −0.16	Small effects confined to the most extreme categories

Source: *Author's calculation based on survey data (N = 349).*

4. Discussion

4.1 Principal Findings

In this online convenience sample of students and workers, perceived sleep quality was the dominant correlate of self-rated productivity. It showed a medium-sized, graded association with productivity ($\rho = 0.40$), remained significant after adjustment for sleep duration, wellbeing, screen time and demographic and work characteristics ($\beta = 0.46$), and was robust to alternative codings, robust standard errors and exclusion of minors. Reported sleep duration, in contrast, showed only a negligible

bivariate association (≈ 1% shared variance) that disappeared after adjustment. The more modest findings for daytime tiredness, stress and low motivation were small and confined to the extreme response categories.

The weak role of duration is compatible with the view that perceived restoration, and not hours alone, shapes how people judge their day, and with the multidimensional view of sleep that underlies instruments such as the PSQI, in which duration is only one component (Buysse et al., 1989). It sits less comfortably with experimental evidence of dose-dependent cognitive costs of sleep restriction (Van Dongen et al., 2003; Lim & Dinges, 2010), and with observational work in which duration predicts performance (Okano et al., 2019). Several features of our measurement may attenuate a true duration effect: four coarse, overlapping bands; a top category of "more than 7 hours" that mixes ordinary and excessive sleep; only 7.7% of respondents in the shortest band; and a subjective productivity rating that is itself imprecise. We therefore interpret the duration result as "no meaningful association detectable with these measures" and not as evidence that duration is unimportant.

Tiredness was only weakly and non-monotonically related to productivity: respondents who were never tired did not report the highest productivity. A plausible reading is that the relationship is carried by the minority who are tired most days or always, and that people who never feel tired include some with low engagement; this is speculative, and the non-significant pairwise tests warrant caution. Tiredness was no longer significant after adjustment ($p = .105$ in Model 3). It was almost uncorrelated with sleep quality ($\rho = -.01$) but moderately correlated with stress ($\rho = .38$), and in a supplementary check the tiredness coefficient fell from -0.30 ($p = .021$) to -0.24 ($p = .087$) when stress was added to a model containing sleep quality, so its small association appears to overlap with stress and motivation rather than with sleep quality.

4.2 Implications

The results suggest that, when brief surveys or workplace and campus programmes assess sleep in relation to functioning, asking about perceived sleep quality adds information beyond hours slept. Because the data are cross-sectional and self-reported, they do not show that improving sleep quality would raise productivity. We also do not offer advice on caffeine, screen use or sleep routines: these behaviours were examined (Section 3.6) and were not associated with sleep quality or productivity in this sample, so the data neither support nor justify recommendations about them. Whether they influence sleep is a question for designs that measure them precisely, such as experimental or diary-based studies.

4.3 Limitations

- **Single-Item, Non-Validated Measures.** Sleep quality and productivity were each assessed with one self-rated item. Single items cannot be assessed for internal consistency, are more vulnerable to individual differences in scale use, and capture sleep quality more coarsely than the PSQI, ISI or ESS (Buysse et al., 1989; Bastien et al., 2001; Johns, 1991). Productivity was self-appraised and not benchmarked against objective output; its convergent association with task completion (Section 3.7) is encouraging but also self-reported.
- **Common-Method Bias.** Predictors and outcome were collected from the same respondents, at the same time, with the same response format. Shared method variance, mood, general positivity or negativity, and social desirability can inflate correlations between self-reports (Podsakoff et al., 2003). The strong association between two single self-ratings is the most exposed to this bias, and respondents in a low mood may rate both their sleep and their productivity poorly. Anonymity and the use of different response formats for some items reduce, but cannot remove, this concern, and we did not include a marker variable or a separate source for the outcome.
- **Reverse Causality and Confounding.** The design cannot establish direction. Poor sleep may lower productivity, but low productivity, workload, stress or rumination may equally worsen sleep quality (Åkerstedt, 2006; Kahn et al., 2013), and unmeasured factors such as depressive symptoms, chronic illness, caregiving, shift work or sleep disorders may influence both. The regression models adjust

only for the measured covariates and their coefficients describe conditional associations, not effects.

- **Sampling and Generalisability.** Recruitment was by convenience, the response rate is unknown, and the sample is not representative of any defined population; 11.7% of respondents were self-employed and 11.7% selected an unspecified "other" occupation. Respondents under 18 years (n = 12) form a very small subgroup whose consent procedure must be documented; their exclusion did not alter the findings.
- **Duration Coding.** Overlapping band labels allow misclassification at 6 h, and bands cannot show exact hours or adherence to the 7-hour recommendation. Sleep timing, regularity and sleep disorders were not modelled.
- **Instrument Error.** Item 21 included an invalid response option ("Improved"), selected by 110 respondents (31.5%); the item was excluded from the main analysis, and those respondents may differ systematically from the rest.
- **Statistical Power and Multiplicity.** The study could detect correlations of about $|\rho| \geq .15$; smaller associations (including a true small duration effect) may have gone undetected. Exploratory tests were Holm-adjusted, but the hypothesis tests were not adjusted for multiplicity.
- **Outcome Properties.** The 1–10 productivity rating is bounded, which may produce ceiling effects; no respondent used 0.

4.4 Future Research

Future work should measure sleep with validated instruments (PSQI, ISI and ESS) and, ideally, wearable or actigraphic data and sleep diaries with exact bed and wake times; use validated or objective productivity and performance outcomes, ideally from sources independent of the respondent; use longitudinal or experience-sampling designs to separate within-person effects from stable between-person differences and to examine reverse causality; sample defined populations with documented response rates; and include measures of depressive symptoms and sleep disorders as confounders.

5. Conclusion

Among a mixed sample of students and workers, higher perceived sleep quality was moderately and independently associated with higher self-rated productivity, whereas reported sleep duration was only negligibly associated and daytime tiredness, stress and low motivation showed small associations at their extreme categories. Because of single-item self-reports, common-method variance and the cross-sectional design, these associations should be treated as hypothesis-generating and not as evidence that improving sleep quality increases productivity.

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