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Subjective sleep quality and sustained attention before and after a 24-hour smartphone restriction in adolescent swimmers: a single-group pretest–posttest study

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Abstract

Background Excessive smartphone use among adolescents has been associated with poorer sleep and attention, but evidence on short-term restriction in young athletes is limited. This study examined changes in subjective sleep quality and sustained attention in adolescent swimmers before and after a 24-hour smartphone restriction period.

Methods In this single-group pretest–posttest study, 43 competitive swimmers aged 10–16 years (12.84 ± 1.90 years; 26 male) completed a 24-hour smartphone restriction, verified with tamper-evident sealed bags. Subjective sleep quality was assessed with a 10-cm visual analogue scale (VAS; 0 cm = good, 10 cm = poor sleep) and sustained attention with the Bourdon Attention Test (accuracy and completion time) immediately before and after the restriction period.

Results VAS sleep scores decreased from 2.93 ± 1.96 to 1.91 ± 1.80 cm (mean difference −1.01, 95% CI −1.46 to −0.56; $p < .001$; dz = 0.69), indicating better self-rated sleep quality after the restriction period. Bourdon total accuracy increased by 6.30 correct responses (95% CI 3.80 to 8.80; $p < .001$; dz = 0.78) and total completion time decreased by 32.4 s (95% CI 20.5 to 44.3; $p < .001$; dz = 0.84). Pre–post changes did not differ detectably by sex or habitual screen time; swimmers with higher habitual screen time reported poorer sleep across both sessions ($p = .023$, $\eta p^2 = 0.12$).

Conclusions In adolescent swimmers, self-rated sleep quality, Bourdon Attention Test accuracy and completion time improved after a 24-hour smartphone restriction period. Because the study had no control condition, these changes cannot be attributed specifically to smartphone restriction and may partly reflect practice effects; randomised controlled studies are needed.

Trial registration Not applicable. (This study evaluated a behavioral intervention in an athletic training setting rather than a clinical trial).

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Keywords Smartphone restriction · Adolescent health · Sleep quality · Sustained attention · Adolescent swimmers

Background

Smartphone use is now almost universal among adolescents, and heavy or night-time use has repeatedly been associated with poorer sleep and attention [1–5]. A meta-analysis of 20 studies in children and adolescents found that bedtime use of portable media devices, and even their mere presence in the bedroom, was associated with inadequate sleep quantity, poor sleep quality and excessive daytime sleepiness [6]. Experimental and observational studies further indicate that smartphone notifications and the presence of one's own phone can disrupt sustained attention [7–9]. Most of this evidence, however, is cross-sectional, and intervention studies have mainly examined evening screen curfews over several weeks [10].

Sleep and sustained attention are particularly relevant for adolescent athletes, who combine school with demanding training schedules. Psychological and cognitive factors are recognised determinants of performance decline, burnout and recovery in competitive athletes [11], insufficient sleep has been associated with impaired performance, recovery and cognitive function in athletes [12–15], and smartphone or social-media use before training or competition has been associated with mental fatigue and poorer decision-making in experimental studies of adult athletes [16–18]. Whether a short, complete break from the smartphone is followed by changes in sleep and attention in young athletes has not been examined. A 24-hour restriction is a pragmatic period in this context: it can be implemented within a normal training week without disrupting schooling, and it covers one night of sleep and the following morning, when attention can be assessed before training.

Responses to a restriction may also depend on individual characteristics. Adolescent girls and boys differ in how they use screen devices—girls report more mobile phone and social-media use, whereas boys report more gaming [19]—and habitual screen time shows a dose–response association with poorer sleep [6, 19]. Swimmers with higher habitual use might therefore have more scope for change. These questions were examined as exploratory secondary aims.

The aim of this study was to examine changes in subjective sleep quality and sustained attention in adolescent swimmers before and after a 24-hour smartphone restriction period. We expected that self-rated sleep quality would improve (lower VAS scores) and that Bourdon Attention Test accuracy would increase and completion time decrease after the restriction period. As exploratory aims, we examined whether these changes differed by sex and by habitual daily screen time.

Methods

This single-group pretest–posttest study examined changes in subjective sleep quality and sustained attention in adolescent swimmers before and after a 24-hour smartphone restriction period. Each participant was tested in two sessions 24 h apart, immediately before and at the end of the restriction period.

Participants

Participants were recruited through their coaches from Aykon Sports Club, Türkiye. The coaches informed swimmers and their parents about the study, and those who expressed interest received written information before giving consent. Inclusion criteria were: (i) age 10–16 years; (ii) regular participation in competitive swimming training, with daily evening sessions during the study period; (iii) ownership and daily use of a personal smartphone; and (iv) written informed consent from the swimmer and a parent or legal guardian. Exclusion criteria were: (i) a diagnosed sleep disorder; (ii) a diagnosed neurological, psychiatric or neurodevelopmental condition

likely to affect attention; (iii) current use of medication known to affect sleep or attention; and (iv) acute illness or injury preventing normal training during the study week. Eligibility was checked with the swimmers and their parents before enrolment. Forty-five swimmers were enrolled; one withdrew voluntarily and one was excluded for a protocol violation (see Procedure), leaving 43 participants for analysis.

The sample size was calculated in G*Power (version 3.1.9.7) for the primary pre–post comparison (ANOVA: repeated measures, within factors; one group; two measurements; $f=0.25$, corresponding to $dz=0.50$; $\alpha=0.05$; $1-\beta=0.80$; correlation among repeated measures $r=.50$; nonsphericity correction $\varepsilon=1$), indicating a minimum of 34 participants. Forty-five swimmers were recruited to allow for attrition. A sensitivity analysis indicated that, with 43 participants, the exploratory Time × Group interactions (two groups, two measurements, $r=.50$) had 80% power only for effects of $f\geq0.22$; these analyses were therefore not powered to establish the absence of subgroup differences.

Habitual daily screen time was obtained from the smartphones' system logs and verified with the participants and their parents. The study protocol was approved by the institutional ethics committee (see Declarations).

Procedure

Both sessions were conducted individually in a quiet, well-lit room at room temperature between 10:00 and 14:00, before the swimmers' daily training, with the researcher standing behind the participant during the attention test. Each participant's post-test was scheduled 24 h after his or her baseline session. During the study week, the swimmers trained in the evening (16:00–18:00), with an average volume of approximately 5 km per day of predominantly aerobic swimming.

At the start of the first session, after the protocol had been explained, each participant's smartphone was switched off and sealed in a tamper-evident evidence bag in the presence of the researcher (Fig. 1). The 24-hour restriction period started at the moment of sealing; baseline testing (VAS, followed by the Bourdon Attention Test) was completed immediately afterwards. During the restriction period, participants were instructed not to use their own or any other smartphone, tablet or computer. Parents were informed about the protocol, asked to supervise adherence at home, and asked at the second session whether any device had been used. Twenty-four hours after sealing, the integrity of each bag was checked and the VAS and the Bourdon Attention Test were repeated in the same order (Fig. 2). All bags were intact; one participant was excluded because a parent reported that the participant had used another device during the restriction period. Sleep schedule, caffeine intake and daytime activities were not controlled, but participants followed their usual training schedule. Participants rated the sleep of the night preceding each test session, i.e., the night before the restriction period at baseline and the night within the restriction period at post-test.

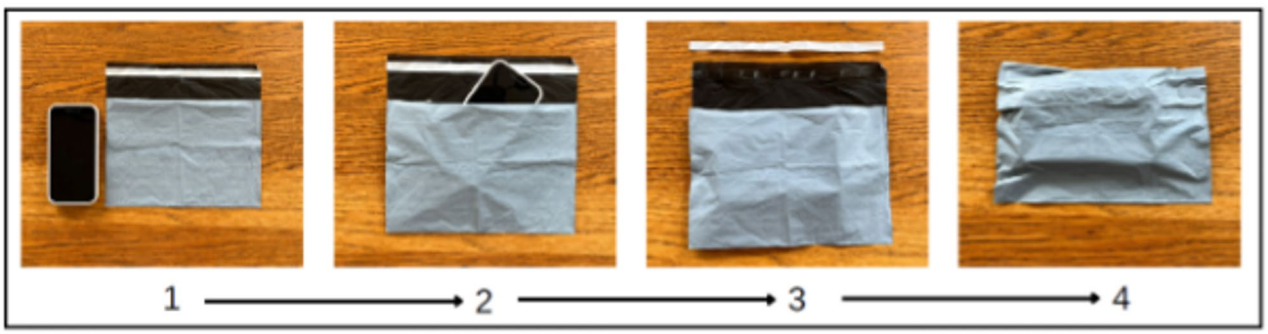


Fig. 1 Steps for sealing smartphones in an evidence bag

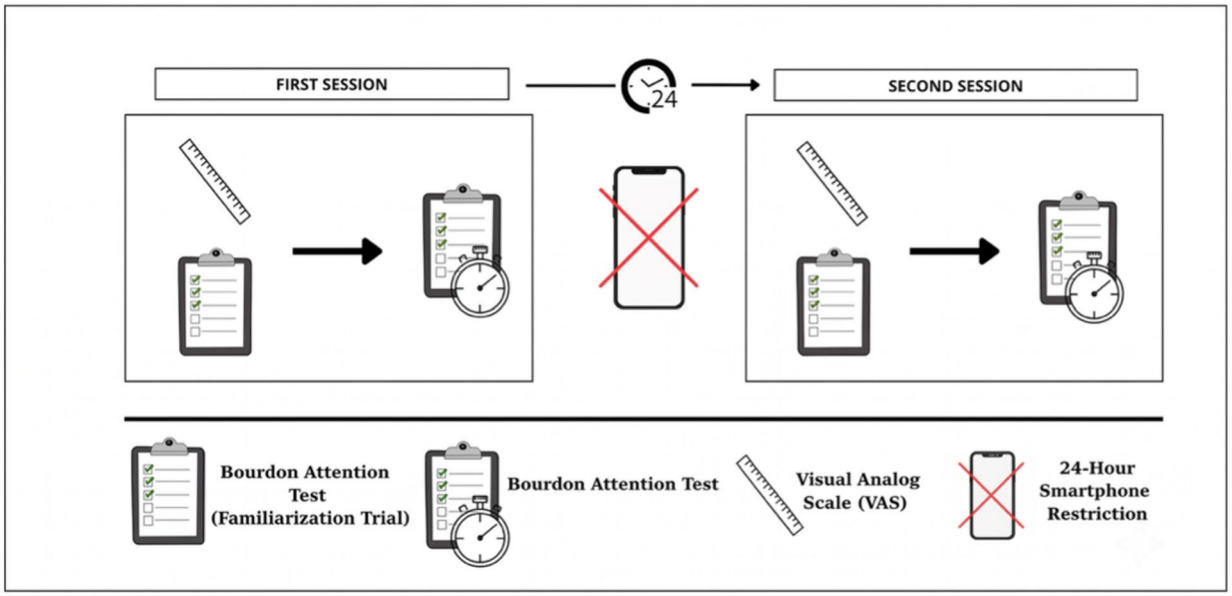


Fig. 2 Study design overview

Bourdon attention test

The Bourdon Attention Test was administered as a paper-and-pencil letter-cancellation task in which participants cancelled the target letters "a, b, d and g" within a 660-letter matrix divided into three blocks containing 41, 37 and 40 targets, respectively (118 targets in total) [20–23]. The target letters, number of targets per block and matrix size were identical in both sessions; for the post-test, the positions of the letters were re-randomised using a computer-generated sequence to prevent recall of target locations. The equivalence of the two versions was not tested empirically. Before the test in each session, participants completed a familiarisation trial to reduce practice effects [24]. Accuracy was defined as the number of correctly cancelled targets (maximum 118); omissions were defined as targets not cancelled (118 − accuracy). Incorrect cancellations of non-target letters were not recorded. For block-level analyses, accuracy was expressed as the percentage of targets detected in each block. Completion time for each block and for the whole test was recorded with a stopwatch (s). Time per correct response (s per correct response) was calculated as total completion time divided by the number of correct responses; lower values indicate faster processing.

Subjective sleep quality assessment

Subjective sleep quality was assessed with a 10-cm visual analogue scale [25–27] anchored with "My sleep quality was good" and "My sleep quality was poor". At each session, participants marked the quality of their sleep during the preceding night, and the score was obtained by measuring with a ruler the distance (cm, to one decimal place) of the mark from the "good" anchor. Scores therefore range from 0 cm (good sleep) to 10 cm (poor sleep), with lower scores indicating better perceived sleep quality.

Statistical analysis

Analyses were conducted in JASP (version 0.18.3) and Python (SciPy). Values are reported as mean ± standard deviation (SD), and all inferential analyses used the participant as the unit of analysis ($n = 43$). Pre- and post-test values of the four outcomes—subjective sleep quality (VAS, cm), total accuracy, total completion time and time

per correct response—were compared with paired-samples t-tests. Differences were calculated as post-test minus pre-test and are reported as mean differences with 95% confidence intervals (CIs) and Cohen's dz (mean difference divided by the SD of the differences, reported as an absolute value) [28]. Because some difference scores deviated from normality (Shapiro–Wilk $p < .05$), Wilcoxon signed-rank tests were performed as a sensitivity analysis.

Block-level performance was examined with 2 (Time: pre-test, post-test) × 3 (Block: 1, 2, 3) repeated-measures ANOVAs for percentage accuracy and completion time; sleep quality, which has no block structure, was not included in these models. Sphericity was checked with Mauchly's test, and Greenhouse–Geisser-corrected degrees of freedom are reported. Significant Block main effects were followed by Bonferroni-corrected pairwise comparisons.

To explore whether pre–post changes differed by sex or habitual screen time, separate 2 (Time) × 2 (Group) mixed-design ANOVAs were fitted to the total scores of each outcome, with sex (female, $n = 17$; male, $n = 26$) or screen-time group (median split: < 207 min·day^{-1}, $n = 21$; ≥ 207 min·day^{-1}, $n = 22$) as the between-subjects factor. Sex and screen time were analysed in separate models because of the small subgroup sizes. Because dichotomisation discards information, habitual screen time was also analysed as a continuous variable by regressing pre–post change scores on daily screen time (per 60 min·day^{-1}) and by regressing post-test scores on pre-test scores and screen time. These moderation analyses were exploratory, and non-significant interactions were not interpreted as evidence of equivalent change. ANOVA effect sizes are reported as partial eta squared (ηp^2). Statistical significance was set at $p < .05$ (two-tailed).

Results

Participant characteristics

Forty-three swimmers (26 male, 17 female) aged 10–16 years (12.84 ± 1.90 years) completed both sessions. Mean age was 13.04 ± 1.84 years in male and 12.53 ± 2.00 years in female swimmers. Habitual screen time was 221.5 ± 109.1 min·day^{-1} (median 207 min·day^{-1}; male 221.5 ± 102.7, female 221.5 ± 121.6 min·day^{-1}).

Pre–post changes in sleep quality and attention

Pre- and post-test values are shown in Table 1. VAS sleep scores decreased from 2.93 ± 1.96 to 1.91 ± 1.80 cm (mean difference −1.01 cm, 95% CI −1.46 to −0.56; t(42) = −4.54, $p < .001$, dz = 0.69); because lower scores denote better sleep, this decrease indicates better self-rated sleep quality after the restriction period. Total accuracy increased from 107.86 ± 9.59 to 114.16 ± 3.79 correct responses (+6.30, 95% CI 3.80 to 8.80; t(42) = 5.09, $p < .001$, dz = 0.78). Total completion time decreased from 291.6 ± 76.3 to 259.2 ± 72.9 s (−32.4 s, 95% CI −44.3 to −20.5; t(42) = −5.49, $p < .001$, dz = 0.84), and time per correct response decreased from 2.72 ± 0.71 to 2.27 ± 0.63 s

Table 1 Paired comparison of subjective sleep quality and attention performance 24 h pre- and post-SR

Variable	Pre-test	Post-test	t	*p*	Cohen's d
Subjective Sleep Quality	2.92 ± 1.95	1.91 ± 1.79	4.537	**<0.001*****	0.692
Bourdon Test Total Score	107.9 ± 9.58	114.2 ± 3.79	-5.092	**<0.001*****	-0.776
* Block 1 Score	38.12 ± 3.74	40.05 ± 1.27	-3.673	**<0.001*****	-0.560
* Block 2 Score	33.40 ± 3.26	35.40 ± 1.97	-3.937	**<0.001*****	-0.600
* Block 3 Score	36.35 ± 3.89	38.72 ± 1.54	-4.954	**<0.001*****	-0.755
Bourdon Test Total Time (sec)	291.6 ± 76.30	260.5 ± 72.67	5.055	**<0.001*****	0.771
* Block 1 Time	95.91 ± 5.42	84.77 ± 25.35	4.735	**<0.001*****	0.722
* Block 2 Time	97.47 ± 27.86	87.88 ± 25.66	3.935	**<0.001*****	0.600
* Block 3 Time	98.19 ± 27.59	87.88 ± 25.66	3.521	**<0.001*****	0.537

Note. VAS: Visual Analog Scale; df: Degrees of freedom. Data are presented as mean ± standard deviation. Pre-test–post-test differences were significant for all parameters ***$p < .001$

per correct response (−0.45, 95% CI −0.57 to −0.32; t(42) = −7.37, $p < .001$, dz = 1.12), indicating faster processing at post-test. Wilcoxon signed-rank tests led to the same conclusions (all $p < .001$). At post-test, 15 participants detected at least 117 of the 118 targets, indicating a ceiling effect for accuracy.

Values are mean ± SD. Differences are post-test minus pre-test. dz, Cohen's effect size for paired data (absolute value; the direction of change is given by the mean difference). †Distance (cm) of the mark from the "My sleep quality was good" anchor (0 cm = good, 10 cm = poor); lower scores indicate better perceived sleep quality. ‡Total completion time divided by the number of correct responses; lower values indicate faster processing.

Block-level attention performance

Block-level results are presented in Fig. 3 and Additional file 1. For percentage accuracy, there were significant main effects of Time ($F(1, 42) = 25.94$, $p < .001$, $\eta p^2 = 0.38$) and Block ($F(1.98, 83.11) = 5.49$, $p = .006$, $\eta p^2 = 0.12$), whereas the Time × Block interaction was not significant ($F(1.81, 76.10) = 0.46$, $p = .617$, $\eta p^2 = 0.01$). Averaged across sessions, accuracy was higher in Block 1 than in Block 2 (mean difference 2.36% points, pBonf = 0.004); Block 3 did not differ from Block 1 (pBonf = 0.134) or Block 2 (pBonf = 0.752). For block completion time, the main effect of Time was significant ($F(1, 42) = 30.09$, $p < .001$, $\eta p^2 = 0.42$), whereas neither the Block main effect ($F(1.90, 79.90) = 0.99$, $p = .372$, $\eta p^2 = 0.02$) nor the Time × Block interaction ($F(1.85, 77.66) = 0.05$, $p = .941$, $\eta p^2 = 0.001$) was significant. Thus, the pre–post change in accuracy and completion time did not differ detectably across the three blocks; this does not demonstrate that the change was equivalent across blocks.

Exploratory analyses by sex and habitual screen time

Results of the separate mixed-design ANOVAs are reported in Table 2. In the sex models, the main effect of Time was significant for sleep quality ($F(1, 41) = 18.75$, $p < .001$, $\eta p^2 = 0.31$), total accuracy ($F(1, 41) = 22.43$, $p < .001$, $\eta p^2 = 0.35$) and total completion time ($F(1, 41) = 29.36$, $p < .001$, $\eta p^2 = 0.42$). Neither the main effect of sex nor the Time × Sex interaction was significant for sleep quality (interaction $F(1, 41) = 0.07$, $p = .786$, $\eta p^2 = 0.002$), accuracy ($F(1, 41) = 2.46$, $p = .124$, $\eta p^2 = 0.06$) or completion time ($F(1, 41) = 0.24$, $p = .625$, $\eta p^2 = 0.006$). The

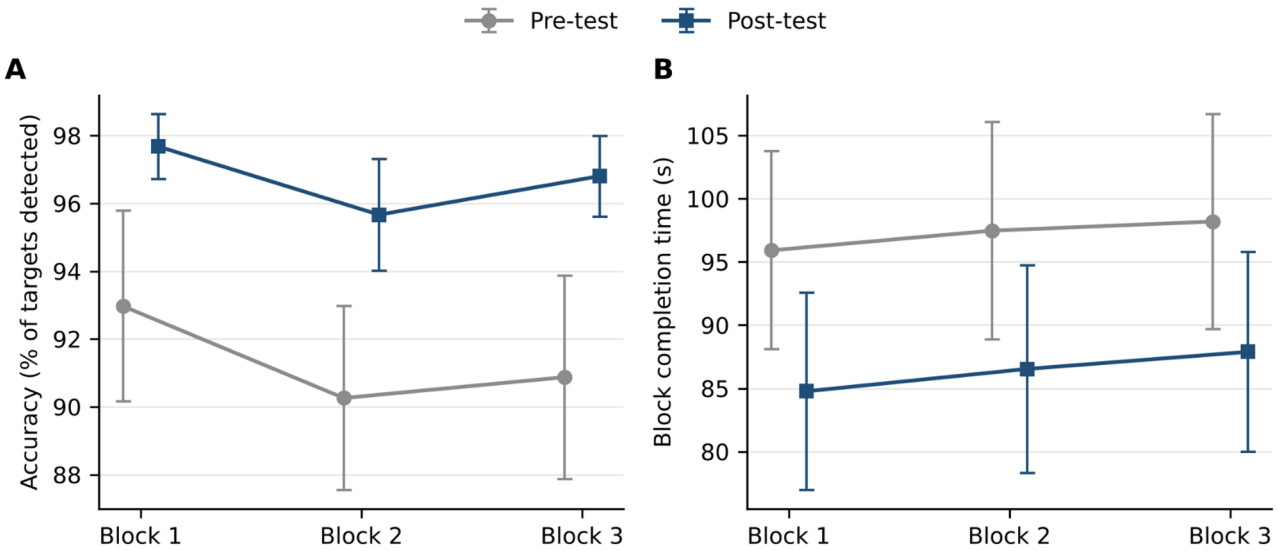


Fig. 3 Block-level Bourdon Attention Test performance before and after the 24-hour smartphone restriction period ($n = 43$). **A** Accuracy, expressed as the percentage of targets detected in each block; **B** completion time for each block. Values are means with 95% confidence intervals

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Table 2 A Comparison of the effect of daily screen time on subjective sleep quality and attention performance before and after the SR Note: The data are presented as mean ± standard deviation. ω^2: Omega-squared effect size coefficient

	Low Group Female Pre	Low Group Female Post	Low Group Male Pre	Low Group Male Post	High Group Female Pre	High Group Female Post	High Group Male Pre	High Group Male Post	Within-Subjects			
										F	*p*	ω^2
Subjective Sleep Quality	1.36 ± 1.30	1.12 ± 1.14	2.79 ± 1.65	1.53 ± 1.03	4.25 ± 2.47	2.70 ± 2.38	3.10 ± 1.61	2.23 ± 2.13	Time	20.15	**< 0.001*****	0.071
									Time*Screen Time	0.398	0.532	0.000
									Between-Subjects			
										F	***p***	ω^2
									Screen Time	5.560	**0.023***	0.051
									Within-Subjects			
										F	***p***	ω^2
Burdon Test Total Score	111 ± 4.92	113.5 ± 4.56	107.2 ± 9.43	115 ± 3.53	108.9 ± 6.15	114.1 ± 3.75	105.8 ± 13.46	113.8 ± 3.87	Time	25.30	**< 0.001*****	0.152
									Time* Screen Time	0.178	0.675	0.000
									Between-Subjects			
										F	***p***	ω^2
									Screen Time	0.316	0.577	0.000
									Within-Subjects			
										F	***p***	ω^2
Burdon Test Total Time	333.5 ± 44.21	265.3 ± 44.04	287.5 ± 58.80	259.8 ± 59.51	265 ± 81.45	235.9 ± 63.58	288.2 ± 98.10	275.5 ± 102	Time	27.84	**< 0.001*****	0.041
									Time* Screen Time	3.987	0.053	0.005
									Between-Subjects			
										F	***p***	ω^2
									Screen Time	0.429	0.516	0.000

Note:The data are presented as mean ± standard deviation. ω^2: Omega-squared effect size coefficient

point estimate for the accuracy gain was larger in male than in female swimmers (7.85 vs. 3.94 correct responses; difference 3.90, 95% CI −0.28 to 8.09), but the CI was wide and included zero.

Values are mean ± SD. Sex and screen time were analysed in separate models; df = (1, 41) for all effects. Screen-time groups were formed by a median split of habitual daily screen time (low < 207 min·day^{-1}; high ≥ 207 min·day^{-1}). §Mean change in the second-listed group (male; high screen time) minus mean change in the first-listed group (female; low screen time). A non-significant interaction indicates that no difference in change was detected; it does not establish equivalent change.

In the screen-time models, swimmers in the high-screen-time group had higher (i.e., poorer) VAS sleep scores across both sessions than those in the low-screen-time group (main effect of group: $F(1, 41) = 5.56$, $p = .023$, $\eta p^2 = 0.12$; pre-test 3.57 ± 2.04 vs. 2.25 ± 1.66 cm). The Time × Screen-time interaction was not significant for sleep quality ($F(1, 41) = 0.40$, $p = .532$, $\eta p^2 = 0.01$), accuracy ($F(1, 41) = 0.18$, $p = .675$, $\eta p^2 = 0.004$) or completion time ($F(1, 41) = 0.16$, $p = .692$, $\eta p^2 = 0.004$). When screen time was analysed as a continuous variable, it was associated with poorer baseline sleep scores ($r = .34$, $p = .024$) but not with the pre–post change in sleep quality (b = 0.06 cm per 60 min·day^{-1}, 95% CI −0.19 to 0.31, $p = .64$), accuracy (b = 0.48 correct responses, 95% CI −0.92 to 1.88, $p = .49$) or completion time (b = 5.98 s, 95% CI −0.46 to 12.42, $p = .068$). Results were similar when post-test scores were adjusted for pre-test values (all $p \geq .054$).

Discussion

In this single-group study, self-rated sleep quality, Bourdon Attention Test accuracy and completion time improved after a 24-hour smartphone restriction period in adolescent swimmers. Because there was no control condition, these changes cannot be attributed specifically to the restriction and may partly reflect practice, expectancy or day-to-day variation (see Limitations).

The improvement in self-rated sleep quality is consistent with studies associating evening and bedtime use of portable media devices with poorer sleep in adolescents [6, 29, 30] and with improved sleep when adolescents reduced evening screen use [10]. Several mechanisms could plausibly contribute, including reduced evening light exposure and its possible influence on melatonin secretion [31], less pre-sleep cognitive and emotional arousal from notifications and social media, and less displacement of sleep time. However, none of these mechanisms was measured in the present study, and the observed change in VAS scores could also reflect expectancy or day-to-day variation in sleep. These explanations should therefore be regarded as hypotheses for future studies using objective sleep measures.

Swimmers in the high-screen-time group reported poorer sleep (higher VAS scores) across both sessions than those in the low-screen-time group, and continuous screen time was associated with poorer baseline sleep scores. This between-group difference is consistent with studies linking greater digital media use to poorer sleep in adolescents [29, 30]. However, the Time × Screen-time interaction was not significant, and screen time was not associated with the magnitude of the pre–post change. The groups therefore differed in their overall sleep scores, but there was no statistical evidence that their change over the restriction period differed. Given the modest subgroup sizes, this should not be interpreted as evidence that the restriction affected both groups equally.

Bourdon Attention Test accuracy increased and completion time decreased after the restriction period. Previous work has shown that the mere presence of one's own smartphone can reduce available cognitive capacity [9] and that notifications can disrupt sustained attention [8], which offers one possible explanation. However, the same pattern would be expected from practice with a repeated test, particularly over a 24-hour interval: scores on the familiarisation trial also improved, participants with lower baseline accuracy improved most, and accuracy approached the test maximum at post-test. Performance differed modestly between blocks, with lower accuracy in Block 2, but the pre–post change did not differ detectably across blocks. Because mental fatigue was not measured, these block-level findings cannot be interpreted in terms of fatigue resistance.

Neither the main effect of sex nor the Time × Sex interaction was significant for any outcome. These findings indicate that no sex-related difference in change was detected; they do not demonstrate that female and male swimmers responded identically. The confidence intervals for the differences in change were wide, and the study was not powered to detect small-to-moderate interaction effects ($f < 0.22$).

From a practical perspective, the 24-hour restriction was feasible in this setting: all sealed bags were intact, and only one participant was excluded for using another device. If the present changes are confirmed in randomised controlled studies with objective sleep measures and sport-specific outcomes, short smartphone breaks could be evaluated as a simple, low-cost strategy for young athletes.

Limitations

The principal limitation of this study is the absence of a randomised no-restriction control condition. In a single-group pretest–posttest design, changes between sessions cannot be separated from repeated-testing (practice) effects, expectancy effects, natural day-to-day variation in sleep and attention, or regression towards the mean. Several observations suggest that these influences were plausible: scores on the brief familiarisation trial also increased between sessions, participants with lower baseline values showed larger improvements, and 15 participants approached the maximum accuracy score at post-test, indicating a ceiling effect. The findings should therefore be interpreted as changes observed after the restriction period rather than as effects of the restriction. Second, the equivalence of the original and re-randomised versions of the Bourdon Attention Test was not tested empirically, its test–retest reliability was not assessed in this sample, and incorrect cancellations were not recorded. Third, adherence to the restriction on devices other than the sealed smartphone relied on parental supervision and report, and sleep schedule, caffeine intake and daytime activity were not controlled. Fourth, sleep quality was assessed with a single-item subjective scale rather than objective methods such as actigraphy or polysomnography. Fifth, the subgroup analyses were exploratory and not powered to detect small-to-moderate interaction effects. Finally, the sample consisted of adolescent swimmers from a single club (Aykon Sports Club), which limits generalisability to other sports and populations.

Conclusions

Among adolescent swimmers, self-rated sleep quality improved, Bourdon Attention Test accuracy increased and completion time decreased after a 24-hour smartphone restriction period. Because the study lacked a control condition, these changes cannot be attributed specifically to smartphone restriction and may partly reflect practice effects. Randomised controlled studies, ideally including objective sleep measures and sport-specific outcomes, are needed before short-term smartphone restriction can be recommended in training or competition settings.

Abbreviations

- ANOVA Analysis of Variance
- CI Confidence interval
- cm Centimeter
- min Minute
- p p-value
- p_{bonf} Bonferroni-corrected p-value
- SD Standard Deviation
- VAS Visual Analogue Scale
- ηp^2 Partial eta squared

Supplementary information The online version contains supplementary material available at https://doi.org/10.1186/s12887-026-07951-8.

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Author contributions Authors' Contribution GD: Conceptualization, Methodology, Data Collection, Writing — Original Draft, Writing — Reviewing & Editing, Visualization DF: Methodology, Data Collection, Data Curation and Analysis, Writing — Original Draft, Writing — Reviewing & Editing, Visualization OA: Conceptualization, Supervision HG: Methodology, Writing — Reviewing & Editing, Visualization EG: Conceptualization, Methodology, Data Curation and Analysis, Writing — Original Draft, Writing — Reviewing & Editing, Visualization, Supervision

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Data availability The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate The study was approved by the Health Sciences Ethics Committee of the Faculty of Medicine, Manisa Celal Bayar University, Türkiye (date: 11/03/2026; decision no: 20.478.486/3366) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants and their parents or legal guardians before participation.

Consent for publication Not applicable. (The manuscript does not contain any individual personal data, identifying details, images, or videos of participants).

Declaration of AI Use During the preparation of this work, the authors used Grammarly and ChatGPT4.0 to improve the readability and language. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

Competing interests The authors declare no competing interests.

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