The CONSORT reporting checklist

Title of manuscript:
Effectiveness of an 8-Week Mobile App-Based Corrective Exercise Program on Neck and Shoulder Alignment in Male University Students: A Follow-Up Study on Retention of Improvements

Name of journal:
BMC Sports Science, Medicine and Rehabilitation

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> **Note**
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> If you have not used a reporting guideline before, read about how and why to use them and check whether CONSORT is the most applicable reporting guideline for your work.
>
> Reporting guidelines are most useful when used early in research. When writing a manuscript or application, consider using the Full Guidance where you'll see explanations and examples for each item.
>
> After writing, demonstrate adherence by completing this checklist:
>
> 1. Specify where each item is described (see Note 1).
> 2. Cite this checklist (See Note 2).
> 3. Include your completed checklist as a supplement when submitting to a journal so that future readers can use it to find information.

	Item Description	Location (or reason for not reporting)
Title and Abstract		—
1a. Title	Identification as a randomised trial: The manuscript title is provided on page 1. The title does not explicitly include the phrase "randomised trial"; however, the Methods section describes random assignment of participants to three groups.	p. 1
1b. Structured Abstract	Structured summary of the trial design, methods, results, and conclusions. The abstract reports the quasi-experimental design, pre-test/post-test/follow-up phases, eligibility and allocation, intervention, outcome measures, statistical methods, results, and conclusion.	p. 1
Open Science		—
2. Trial Registration	Name of trial registry, identifying number (with URL) and date of registration. The manuscript reports registration in the Iranian Registry of Clinical Trials (IRCT), identifier IRCT20110803007211N7, with registration date 2026-04-27.	p. 17
Protocol and statistical analysis plan	Where the trial protocol and statistical analysis plan can be accessed. A separate published protocol or statistical analysis plan is not reported. The statistical analysis methods are described in the manuscript.	Not reported as a separate protocol/SAP; statistical analysis is on p. 12.
4. Data sharing	Where and how the individual de-identified participant data, statistical code, and other materials can be accessed. The manuscript states that data supporting the findings are available from the corresponding author upon reasonable request.	p. 17

5. Funding and Conflicts of Interest		—
5a. Funding	Sources of funding and other support (eg, supply of drugs), and role of funders in the design, conduct, analysis, and reporting of the trial. The authors declare that they did not receive any financial support during the preparation of this manuscript. There were no external funders involved in the design, conduct, analysis, or reporting of the trial.	p. 17
5b. Conflicts of interest	Financial and other conflicts of interest of the manuscript authors. The authors declare no competing interests or financial conflicts of interest related to the manuscript.	p. 18
Introduction		—
6. Background and rationale	Scientific background and rationale. The study addresses the growing concern of poor posture, specifically forward head posture (FHP) and rounded shoulder posture (RSP), which have been linked to increased smartphone usage. These postural issues can lead to musculoskeletal pain, discomfort, and long-term health problems. The rationale for the study is to evaluate the effectiveness of a mobile app-based corrective exercise program in improving these postural issues in male university students. The study also aims to assess the retention of the improvements after the intervention period, given the increasing reliance on digital health interventions.	p. 2
7. Objectives	Specific objectives related to benefits and harms. The primary objective of the study is to evaluate the effectiveness of an 8-week mobile app-based corrective exercise program in improving neck and shoulder alignment, specifically addressing forward head posture (FHP) and rounded shoulder posture (RSP). The secondary objective is to assess the retention of the improvements in posture after a 4-week follow-up period. The study also aims to monitor any potential harms, such as discomfort or injury related to the exercises, though no adverse events were reported.	pp. 2-3
Methods		—
8. Patient and public involvement	Details of patient or public involvement in the design, conduct, and reporting of the trial. No formal patient or public involvement statement is reported in the manuscript.	Not reported in the manuscript.
9. Trial Design	Description of trial design including type of trial (eg, parallel group, crossover), allocation ratio, and framework (eg, superiority, equivalence, non-inferiority, exploratory). The study follows a quasi-experimental design with a parallel group structure. Participants were randomly allocated to three groups: a control group, a mobile app-based corrective exercise group, and a traditional exercise group, with an allocation ratio of 1:1:1. The framework of the study is exploratory, aiming to assess the effectiveness of the mobile app-based intervention in improving posture and retaining improvements after the intervention period.	p. 3
10. Changes to trial protocol	Important changes to the trial after it commenced, including any outcomes or analyses that were not pre-specified, with reason. No specific statement about protocol changes is reported in the manuscript.	Not reported; study procedures are described on pp. 3-4.
11. Trial Setting	Settings (eg, community, hospital) and locations (eg, countries, sites) where the trial was conducted. The trial was conducted at Ferdowsi University of Mashhad in Iran, specifically within the university's physical education department. The participants were male university students from the community, and the study was carried out in an academic setting.	pp. 3-4
12. Eligibility Criteria		—
12a. Participants	Eligibility criteria for participants. The participants in this study were male university students aged 18 to 30 years. Eligibility required participants to have been using a smartphone daily for over a year and spend at least one hour per day on it. Participants had to exhibit forward head posture (head angle < 44°) and rounded shoulder posture (scapular angle < 49°).	p. 3
12b. Other	If applicable, eligibility criteria for sites and for individuals delivering the interventions (eg, surgeons, physiotherapists). There were no specific eligibility criteria for the sites or individuals delivering the interventions. The interventions (corrective exercise program via mobile app and traditional corrective exercise) were delivered by trained researchers and instructors in the university's physical education department.	p. 3
13. Intervention and comparator	Intervention and comparator with sufficient details to allow replication. The manuscript describes the three study groups and provides detailed descriptions of the mobile app, corrective-exercise phases, dosage, follow-up reminders, and detraining control condition.	pp. 3, 7-11
14. Outcomes	Prespecified primary and secondary outcomes, including the measurement variable, analysis metric, method of aggregation, and time point for each outcome. The manuscript reports forward head angle and forward shoulder angle as postural outcomes measured by lateral-view smartphone photography at pre-test, post-test, and four-week follow-up.	pp. 3-4
15. Harms	How harms were defined and assessed. A separate harms or adverse-event assessment is not reported in the manuscript.	Not reported in the manuscript.
16. Sample Size		—

16a. How sample size was determined	How sample size was determined, including all assumptions supporting the sample size calculation. he sample size was determined using G*Power software with an effect size of 0.4, an alpha level of 0.05, and a desired power of 0.80. The minimum required sample size per group was calculated to be 11 participants, with a total of 36 participants recruited (12 per group) to account for potential attrition during the study.	p. 3
16b. Interim analyses and stopping criteria	Explanation of any interim analyses and stopping guidelines. No interim analysis or stopping criteria are reported in the manuscript.	Not reported; no interim analysis or stopping rule described.
17. Randomisation		—
17a. Sequence Generation	Who generated the random allocation sequence and the method used. The random allocation sequence was generated by the research team using a random number table. This method ensured a random and unbiased assignment of participants to the different groups (control, intervention A, and intervention B).	pp. 3-4
17b. Type of Randomisation	Type of randomisation and details of any restriction (eg, stratification, blocking, and block size). The study used simple randomisation with no stratification or blocking. Participants were randomly assigned to one of three groups (control, intervention A, and intervention B) using a random number table. There were no restrictions on randomisation or block sizes.	pp. 3-4
18. Allocation concealment mechanism	Mechanism used to implement the random allocation sequence and conceal the sequence until interventions were assigned. The manuscript reports random assignment by random number table/lottery, but does not fully describe allocation concealment.	pp. 3-4.
19. Implementation	Whether the personnel who enrolled and those who assigned participants to the interventions had access to the random allocation sequence. The manuscript describes random assignment, but does not fully describe personnel access to the allocation sequence.	pp. 3-4.
20. Blinding		—
20a. Who was blinded	Who was blinded after assignment to interventions. Blinding is not reported in the manuscript.	Not reported in the manuscript.
20b. How blinding was achieved	If blinded, how blinding was achieved and description of the similarity of interventions. Blinding procedures are not reported in the manuscript.	Not reported in the manuscript.
21. Statistical methods		—
21a. Comparing groups	Statistical methods used to compare groups for primary and secondary outcomes, including harms. Statistical methods such as Repeated Measures ANOVA and ANCOVA (Analysis of Covariance) were used to compare the primary and secondary outcomes between the three groups (control, intervention A, and intervention B). These methods allowed for the assessment of changes in posture (primary outcomes) and musculoskeletal health (secondary outcomes) across different time points. Since no harms were reported, no statistical analysis for harms was conducted.	pp. 1, 11
21b. Definition of who is included in each analysis	Definition of who is included in each analysis and in which group. The manuscript reports that 36 participants were assigned and 33 completed the study after three COVID-19 withdrawals; analysis appears to be based on completers.	pp. 3, 5; completer analysis (n=33) is described.
21c. Missing Data	How missing data were handled in the analysis. Withdrawals are described, but no separate missing-data handling or imputation method is reported.	pp. 3, 5; no separate missing-data method reported.
21d. Additional Analyses	Methods for any additional analyses, distinguishing pre-specified from post hoc. No subgroup, sensitivity, or post hoc analyses are reported in the manuscript.	Not reported in the manuscript.
22. Participant flow, including flow diagram		—
22a. Participant Numbers	For each group, the numbers of participants who were randomly assigned, received intended intervention, and were analysed for the primary outcome. A total of 36 participants were randomly assigned to the study (12 per group). All participants received the intended intervention based on their assigned group: 12 in the control group, 12 in the mobile app-based intervention group, and 12 in the traditional exercise group. A total of 33 participants completed the study and were analysed for the primary outcome (neck and shoulder alignment), with 3 participants withdrawing due to COVID-19.	pp. 3, 6
22b. Losses and exclusions	For each group, losses and exclusions after randomisation, together with reasons. Out of the 36 participants randomly assigned, 3 participants were excluded from the final analysis. Specifically: 2 participants from the control group	pp. 3, 6

	1 participant from the mobile app-based intervention group These participants withdrew from the study due to contracting COVID-19 during the course of the study. Therefore, 33 participants completed the study and were included in the analysis. |	
23. Recruitment		—
23a. Dates	Dates defining the periods of recruitment and follow-up for outcomes of benefits and harms. The recruitment period for the study took place in 2021, and the follow-up period for evaluating the outcomes was 4 weeks after the completion of the 8-week intervention. No harms were reported, and the follow-up was focused on assessing the retention of the benefits (improvement in posture).	p. 3
23b. Reasons for stopping recruitment	If relevant, why the trial ended or was stopped. No early stopping or stopping reason is reported; recruitment/sample size details are described in the Methods.	Not reported; sample size/recruitment described on p. 3.
24. Intervention and comparator delivery		—
24a. As Administered	Intervention and comparator as they were actually administered. The manuscript describes the study groups, research implementation process, mobile application architecture, corrective-exercise phases, dosage, posture-reminder follow-up, and detraining comparison condition.	pp. 4, 7-11
24b. Concomitant Care	Concomitant care received during the trial for each group. Concomitant care is not reported in the manuscript.	Not reported in the manuscript.
25. Baseline Data	A table showing baseline demographic and clinical characteristics for each group. Baseline demographic characteristics are reported in Table 2, and smartphone-use characteristics are illustrated in Figure 9. The groups were comparable at baseline.	pp. 12
26. Numbers analysed, outcomes, and estimation	For each primary and secondary outcome, by group: numbers analysed, outcome results, and estimated effect size/precision where reported. The manuscript reports group means and standard deviations, test statistics, p-values, and effect sizes for forward head angle and forward shoulder angle across study time points in the Results tables and figures. Confidence intervals and binary outcomes are not reported.	pp. 12-15
27. Harms	All harms or unintended events in each group. Harms or unintended events are not reported in the manuscript.	Not reported in the manuscript.
28. Ancillary Analyses	Any other analyses performed, including subgroup and sensitivity analyses, distinguishing pre-specified from post hoc. No ancillary analyses are reported in the manuscript.	Not reported in the manuscript.
Discussion		—
29. Interpretation	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence. The Discussion interprets the posture improvements and retention effects in relation to previous evidence. Harms are not discussed in the manuscript.	pp. 16-17
30. Limitations	Trial limitations, addressing sources of potential bias, imprecision, generalisability, and, if relevant, multiplicity of analyses. The manuscript notes limitations including a small, homogeneous sample and short follow-up period; additional potential sources of bias and multiplicity are not fully discussed.	pp. 1, 16