

Association between the “weekend warrior” physical activity pattern and musculoskeletal health outcomes: a systematic review

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 1 September 2026 and was last updated on 1 September 2026.

INTRODUCTION

Review question / Objective This systematic review aims to synthesize the available evidence on the association between the weekend warrior (WW) physical activity pattern and musculoskeletal health outcomes in adults, and to compare these associations with those observed among inactive (IA), insufficiently active, and regularly active (RA) adults. Specifically, the review examines: (1) whether WW is associated with bone-related outcomes, including bone mineral density and osteoporosis; (2) whether WW is associated with sarcopenia and other musculoskeletal outcomes relative to IA and RA; and (3) whether these associations vary according to characteristics such as age, sex, body mass index, genetic susceptibility, and the timing of physical activity accumulation.

Rationale Although the benefits of physical activity for musculoskeletal health are well established, most previous research has focused on regularly distributed physical activity. Evidence specifically examining the weekend warrior pattern, in which the recommended weekly volume of moderate-to-vigorous physical activity is concentrated within a limited number of days, remains comparatively limited. Existing research on the WW pattern has predominantly focused on cardiometabolic outcomes and mortality, with considerably less attention given to bone and musculoskeletal health. Furthermore, differences in WW definitions, physical activity assessment methods, and comparisons with inactive or regularly active groups make the existing evidence difficult to interpret. A systematic synthesis is therefore needed to determine whether the WW pattern is associated with favorable musculoskeletal health outcomes and whether these associations are broadly comparable to those observed with regularly distributed physical activity.

Condition being studied Musculoskeletal health outcomes in adults, including low bone mineral density, osteoporosis, osteoarthritis, spinal degenerative changes, inflammatory arthritis, sarcopenia, and related musculoskeletal conditions. The review focuses on whether these outcomes are associated with the temporal distribution of weekly physical activity, particularly the weekend warrior pattern.

METHODS

Search strategy PubMed, Web of Science, and Scopus were searched from database inception to June 30, 2026. The search strategy combined the following terms: ("weekend warrior" OR "weekend warriors" OR "WW") AND ("musculoskeletal system" OR "osteoporosis" OR "sarcopenia" OR "osteoarthritis" OR "bone mineral density" OR "BMD" OR "bone health" OR "musculoskeletal disorder"). For Scopus, screening was restricted to records containing the term "weekend warrior." No language restrictions were applied. Reference lists and citation records of relevant publications were additionally examined to identify potentially eligible studies not retrieved through the electronic database searches.

Participant or population Adults aged 18 years or older. No restrictions were imposed on sex, ethnicity, geographical location, or underlying health status, provided that the study evaluated a weekend warrior physical activity pattern and reported at least one relevant musculoskeletal health outcome.

Intervention The exposure of interest is the weekend warrior (WW) physical activity pattern, defined as the concentration of a substantial proportion of weekly physical activity, particularly moderate-to-vigorous physical activity (MVPA), within a restricted number of days or sessions. Definitions were accepted according to the criteria used in individual eligible studies because operational definitions of WW varied across the literature.

Comparator Comparator groups include inactive (IA), insufficiently active, and regularly active (RA) adults, according to the definitions applied in the individual studies. Particular attention is given to comparisons between WW and inactive adults and to direct comparisons between WW and RA where available.

Study designs to be included Observational studies examining the association between the weekend warrior physical activity pattern and

musculoskeletal health outcomes, including prospective cohort and cross-sectional studies.

Eligibility criteria Studies were eligible if they met all of the following criteria: (1) participants were adults aged 18 years or older; (2) the principal exposure represented a weekend warrior physical activity pattern defined according to the concentration of weekly physical activity within a restricted number of days or sessions; (3) at least one relevant comparison group, such as inactive, insufficiently active, or regularly active participants, was included; (4) at least one musculoskeletal health outcome was reported; and (5) physical activity exposure was assessed using either objective or self-reported methods. Studies were excluded if: (1) the WW pattern could not be distinguished from other physical activity patterns; (2) WW was not the main exposure of interest; (3) the publication was a review, conference proceeding, or animal study; (4) no relevant musculoskeletal outcome was reported; or (5) participants had musculoskeletal disorders but the reported outcome variables were unrelated to musculoskeletal health.

Information sources The primary information sources were PubMed, Web of Science, and Scopus. Reference lists and citation records of relevant reviews and original studies were additionally examined to identify potentially eligible studies.

Main outcome(s) The main outcomes are musculoskeletal health outcomes, including bone mineral density (BMD), low BMD, osteoporosis, sarcopenia, osteoarthritis, spinal degenerative changes, inflammatory arthritis, and related musculoskeletal outcomes. Adjusted effect estimates are extracted where available, including hazard ratios (HRs), odds ratios (ORs), and regression coefficients (β), together with their corresponding 95% confidence intervals.

Additional outcome(s) Subgroup findings according to age, sex, body mass index, genetic susceptibility, and activity timing.

Data management A standardized data extraction framework was used to record study characteristics and outcome data. Extracted variables included publication details and country, population source, physical activity assessment method, sample size and participant characteristics, study design and follow-up duration, operational definitions of WW and comparator groups, outcome definitions, effect estimates, and statistical methods. Data extraction

was independently conducted by two reviewers, with additional authors reviewing the extracted data for accuracy and completeness. Discrepancies were resolved through discussion.

Quality assessment / Risk of bias analysis

Methodological quality was assessed according to study design. Prospective cohort studies were evaluated using the Newcastle–Ottawa Scale (NOS), covering participant selection, comparability, and outcome assessment. Scores of 0–3, 4–6, and 7–9 stars were interpreted as low, moderate, and high quality, respectively. Cross-sectional studies were assessed using the 11-item Agency for Healthcare Research and Quality (AHRQ) checklist, with scores of 0–3, 4–7, and 8–11 interpreted as low, moderate, and high methodological quality, respectively. Two reviewers independently conducted the assessments, with disagreements resolved by discussion or consultation with a third reviewer.

Strategy of data synthesis A quantitative meta-analysis was considered inappropriate because of substantial clinical and methodological heterogeneity, including overlapping participant samples from large databases, variation in the operational definitions of the weekend warrior pattern, differences between objective accelerometer-based and self-reported physical activity assessments, and variation in the definitions and diagnostic criteria of musculoskeletal outcomes. Findings were therefore synthesized using a structured narrative synthesis supported by a structured data matrix. Adjusted HRs, ORs, β coefficients, and corresponding 95% confidence intervals were extracted and compared with respect to the direction and magnitude of associations. Particular attention was given to distinguishing comparisons of WW and RA with a common inactive reference group from studies that directly compared WW with RA.

Subgroup analysis Where available, subgroup and stratified analyses were summarized according to age, sex, body mass index, genetic susceptibility, marital status, and the timing of physical activity accumulation. Because a meta-analysis was not performed, subgroup findings were synthesized narratively rather than pooled quantitatively.

Sensitivity analysis No formal review-level quantitative sensitivity analysis was performed because a meta-analysis was not conducted. Sensitivity analyses reported by the included studies, including alternative operational definitions

of the weekend warrior pattern and different weekly MVPA thresholds, were extracted and narratively summarized where available.

Language restriction No.

Country(ies) involved China.

Other relevant information This protocol is being registered retrospectively. The systematic review had been completed at the time of registration but had not yet been published. The registration is intended to provide a transparent public record of the review objectives, eligibility criteria, search methods, quality assessment procedures, and synthesis strategy.

Keywords weekend warrior; physical activity pattern; musculoskeletal health; bone mineral density; osteoporosis; sarcopenia; osteoarthritis.

Dissemination plans The findings will be submitted for publication in a peer-reviewed academic journal and may also be disseminated through academic presentations and related scholarly activities.

Contributions of each author

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