

level assessment. The relative change of pelvic tilt angle was difference in moving the legs and tends to increase pelvic angulation when increasing ankle weight.

Impact/Application to the field: The method might be useful for prevention of various musculoskeletal conditions such as low back pain and muscle strain, and for assessing the effect of rehabilitation. In addition, this method will help establish an evaluation criterion for trunk stability.

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Movement variability in runners with a current or recent musculoskeletal injury: a systematic review

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Introduction: The abundant degrees of freedom available in movement result in the inherent variations observed in the performance of a repetitive task, i.e., movement variability. Emerging evidence suggests that identification of deviations in gait parameters of pathological vs. healthy runners could advance our current understanding of overuse injury mechanisms in running related injuries. To date the relationship between running biomechanics, variability and injury remains unclear. The purpose of this review was twofold: (1) to examine the impact of musculoskeletal injury on running gait variability; and (2) to identify potentially maladaptive variations in movement variability by identifying any common deviations that occur in injured populations.

Methods: Medline, CINAHL, Embase, Cochrane library and SPORTDiscus databases were searched until February 2022. Studies were eligible for inclusion if they: (a) examined adult participants (≥ 18 years old) with a current or recent history of lower limb or lumbopelvic injury; (b) collected running 3D biomechanics data; (c) compared movement variability data for at least one dependent variable to a control group; and (d) provided a statistical between-group analysis of variability outcomes. Exclusion criteria were neurological conditions that may impact gait or upper body injuries. Due to methodological heterogeneity, a meta-analysis of results was not performed in this review.

Results: Seventeen cross-sectional and retrospective case-control studies were included in the summative synthesis. Significant ($p < .05$) differences in variability outcomes were identified in 73% of runners with current injury-related symptoms and 43% of runners who were asymptomatic or had recovered from a recent injury, when compared to a control group. The most common deviations in movement variability identified in the injured groups were: (1) high and low knee-ankle/foot coupling variability and (2) low trunk-pelvis coupling variability.

Discussion: The results suggest that runners with current injury symptoms often display altered gait variability compared to runners who are injury-free. Pain and ankle instability may drive the neuromuscular system to explore alternative movement strategies in these runners, to reduce painful input or protect the injury site. Potential maladaptive running gait strategies identified in this

review were high/low knee-ankle/foot and low trunk-pelvis coupling variability. Relatively high/low variability is proposed to perpetuate overuse injuries related to running, so these findings are of relevance to clinicians who manage active populations. Further comparison of results was limited due to the diverse underlying theoretical injury models and by the substantial number of biomechanical variables used to measure variability outcomes across the studies.

Impact/Application to the field (can be 1-2 dot points):

- Runners who continue to run with injury symptoms often employ altered and potentially injurious movement variability strategies when compared to those who are injury-free.
- Specific maladaptive variables identified in this review can help to direct future researchers investigating the impact of injury on running variability and address the issue of outcome heterogeneity in movement variability research.

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The effect of the Hiroshima GENKI Exercise on the bone strength and cognitive function in elderly people

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Introduction: In Japan, women account for 66% of those requiring nursing care, mainly due to bone weakening such as bone fractures and joint diseases, and dementia (MHLW, 2021). Exercise trainings in elderly people increase bone density and improve cognitive function, contributing preventions in these diseases. Therefore, the purpose of this study was to verify the effects of "Hiroshima GENKI Exercise," which can be performed by elderly people while sitting in a chair, on bone density and cognitive function in elderly people.

Methods: 49 Japanese elderly females (age: 74.5 ± 11.9 years) were randomly divided into the experimental and control groups. The intervention group underwent the Hiroshima GENKI exercise for 60 min once a week over the course of 3-month. The Hiroshima GENKI exercise was designed to apply mechanical loads and vibration to the bones of the whole body. This training was performed through supervised sessions (group training). The Total Score, Delayed Recall, Working Memory, Judgement and Visuospatial Function were measured by using a Gazefinder that Eye Gaze Measurement Instrument, a well-established screening tool for cognitive function. The speed of sound (SOS) as a quantitative ultrasound parameter of bone was measured before and after the 3-month training.

Results: All cognitive function indicators and SOS did not differ between the groups at the before the 3-month training. After the training, the intervention group significantly increased the Total Score of cognitive function and SOS of bone strength ($p < .05$). No significant changes in the cognitive functions of Delayed Recall, Working Memory, Judgement and Visuospatial Function were found in the intervention group.

Discussion: The Hiroshima GENKI Exercise improved total cognitive scores and SOS. A previous study reported that implementation of the same exercises over a 4-month period in persons requiring nursing care showed significant increases in SOS and walking speed (Yanaoka et al.,