Results Mean NMT warm-up exercise test scores were 72% (SD: 13%) for the control and 71% (SD: 13%) for the intervention workshop. Mean change in NMT warm-up self-efficacy scores were 0.98 (SD: 1.33) for the control and 1.77 (SD: 1.19) for the intervention workshop. Multivariable linear regression analyses indicated that workshop delivery method was not associated with the exercise test score ($b = -3.45$, 95% CI: -10.80 to 3.91, $R^2=0.13$) but was associated with a greater difference in change of self-efficacy scores for the intervention workshop ($b = 0.97$, 95% CI: 0.26 to 1.89, $R^2=0.13$).

Conclusions A P2P learning technology integrated instructional workshop did not differentially impact coaches' ability to identify exercise errors, but it did increase coaches' self-efficacy in identifying exercise errors compared to a standard workshop.

439 BUMBLED VIBRATION: 144 HZ VIBRATION DOES NOT ENHANCE SHOULDER CONTROL

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Background Stability of the upper extremity is critical for injury prevention. Vibration may improve proprioception, reducing injury risk. However, traditional vibration methods may be expensive and require a significant level of skill by the technician.

Objective Our purpose was to investigate whether an acute bout of shoulder exercise performed with an inexpensive, user-friendly vibration toy ball (BumbleBall, Cardinal Laboratories) improves shoulder position sense and joint control.

Design Participants completed an acute bout of shoulder exercise with and without vibration on separate visits. Prior to the exercise bout, participants were assessed for motion sway (path length) using a custom iPhone application previously shown reliable. Path length was reassessed following the exercise bout. A 2-way repeated measures ANOVA was used to determine differences between conditions (vibration/no vibration) and time (pre/post). Significant main effects were examined using paired t-tests - $p < 0.05$.

Setting Liberal arts undergraduate institution.

Patients (or Participants) Thirty subjects (age 18–22) completed all trials. Subject level of activity ranged from non-athletes to collegiate athletes. Exclusion criterion was an upper extremity injury in the previous month.

Interventions (or Assessment of Risk Factors) Sessions started with an app measure. Each subject held the phone on the palm, arm forward at eye level for 20 seconds each arm for all trials. Each subject then completed a full can exercise set with the randomly assigned BumbleBall state (vibration/no vibration), and then repeated the app stability measure. The toy vibrates at 144 Hertz with an amplitude of 8 mm.

Main Outcome Measurements Average path length before and after use of the BumbleBall (vibration/no vibration) assessed this intervention.

Results There was a significant ($p=0.009$ and $\eta_p^2=0.27$) main effect of time. There were no significant ($p>0.05$) 2-way interactions between condition and time.

Conclusions The vibration of this inexpensive toy at 144 Hz did not improve shoulder proprioception.

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EVALUATING EXERCISE FIDELITY DURING NEUROMUSCULAR TRAINING PROGRAMS USING WEARABLE TECHNOLOGY

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Background Evaluating exercise fidelity during neuromuscular training (NMT) warm-ups (i.e., completing prescribed repetitions and performing exercises correctly) is important to inform the dose-response relationship of warm-up programs. Wearable technology can be used to measure exercise fidelity.

Objective To determine the accuracy of measuring NMT exercise volume and quality with wearable technology.

Design Cross-sectional study

Setting Youth basketball; Calgary, Canada

Participants Twenty-seven youth basketball players

Assessment of Risk Factors Players wore a triaxial accelerometer on the lower back during an NMT warm-up with concurrent video recording. A trained observer (physiotherapist) used an observation tool to determine whether each athlete performed the prescribed exercise volume and rate posture.

Main Outcome Measurements The number of repetitions during running, skipping and jumping were extracted from the accelerometer signal using a custom peak detection algorithm and compared to the prescribed exercise volume. The algorithm accuracy was calculated as a percentage, with the trained observer evaluation through video-analysis considered the gold standard.

For the plank, participants were evaluated on 'Good Posture (straight body, head to ankle)' and received a score of 'Yes,' 'No,' or 'Partial.' The coefficient of variation (CV) of the accelerometer signal in all three axes was compared for the three fidelity assessment outcomes.

Results The algorithm had an accuracy of 100% for the running, skipping and jumping exercise volume.

Participants who scored 'Yes' had a lower CV in the medial-lateral (median: 47.2%) and vertical (42.3%) axes, than participants who scored 'Partial' (85.4% and 67.6%) and 'No' (115.1% and 115.5%). There were no differences in CV in the anterior-posterior axis.

Conclusions A custom algorithm can be used to measure the number of running, skipping and jumping repetitions. The variability of the accelerometer signal can identify postural changes during a plank. Accelerometer signals may be used to evaluate movement quantity and quality during NMT.

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LONGITUDINAL CHANGES IN FORCE PLATE MEASURES ARE VALID INDICATORS OF MUSCULOSKELETAL HEALTH IN PROFESSIONAL AMERICAN FOOTBALL PLAYERS

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Background Professional American football players (PAFP) are at high risk for musculoskeletal (MSK) injuries during their season. Little is known about how artificial intelligence (AI) enhanced force plate counter movement jump (CMJ) indices measure musculoskeletal and physiological change, and if these changes across seasons contribute to increased injury risk, especially after an extended layoff from training and participation such as occurred with the Covid-19 lockdown.

Objective Examine longitudinal changes in force plate CMJ measures in PAFP over multiple seasons and to determine if these measures were valid indicators of MSK health. Hypotheses tested: force plate CMJ indices are a valid measure of MSK health and these measures would decrease as injury risk would increase after Covid-19 lockdown.

Design Longitudinal force plate study

Setting Professional American Football

Patients (or Participants) 483 PAFP

Interventions (or Assessment of Risk Factors) Force plate measures in PAFP

Main Outcome Measurements CMJ force plate measures in PAFP

Results 483 unique individuals scanned over four pre-seasons. 109 unique individuals had repeat pre-seasons during that time. 949 force plate CMJ tests were performed over those four pre-seasons. The AI-generated conglomerate variable MSK_Health was on average 47.8 ± 9.7 in 2017, 47.4 ± 10.1 in 2018, 47.5 ± 10.1 in 2019, and 45.0 ± 11.2 in 2020 post-Covid lockdown. ANOVA showed that 2020 measures of MSK_Health were significantly decreased relative to the 3 prior seasons. Logistic regression analysis demonstrated a significant effect of the MSK_Health variable on MSK injury risk.

Conclusions Across multiple seasons of force plate CMJ measures in PAFP, MSK_Health decreased following Covid-19 lockdown, which may be associated with higher risk for MSK injury. This greater understanding of the changes in longitudinal CMJ force plate measures in PAFP across seasons and after extended layoffs may assist in the development of effective MSK injury reduction measures.

442 ABSTRACT WITHDRAWN

443 INJURIES AMONG FOOTBALL GOALKEEPERS: RISK FACTORS AND INJURY PREVENTION PROGRAM – A SYSTEMATIC REVIEW

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Background Previous studies have confirmed different localization of injuries in football goalkeepers (FG) compared to outfield players. However, there is a lack of systematic data regarding the injury epidemiology and potential injury prevention programs that might be implemented in this unique group of players.

Objective 1) To analyze the type and localization of injuries among FG and what are the associated risk factors for these injuries 2) To verify whether there is any injury prevention program tailored for FG.

Design Systematic review of MEDLINE, SPORTDiscus, Web of Science, Scopus, and Cochrane Library electronic databases (search strategy available via the PROSPERO database; 2020 CRD42020183296).

Setting Any football competition level.

Patients (or Participants) The study population consisted of both sexes of amateur or professional FG.

Interventions (or Assessment of Risk Factors) Any paper addressing the issue of injury incidence and/or prevalence and describing injury prevention program/warm-up tailored for goalkeepers.

Main Outcome Measurements Type of injuries, localization of injuries, types of injury prevention programs, injury incidence (injuries/1000 training or match-play hours), percentage distribution of injury type, percentage distribution of injury localization.

Results Our searches identified 813 potentially relevant articles. By reviewing titles and abstracts, we identified 52 potential articles examining type and localization, and risk factors of injuries amongst FG, and biomechanical effects of applying injury prevention accessories (e.g., shorts, pads, etc.). There were no original scientific papers reporting the effectiveness of any tailored injury prevention programs implemented in a FG population. However, there was one short communication published as an abstract, confirming significant reductions in the total number of the upper extremity injuries following the application of FIFA 11+ program (RR=0.42 [0.31–0.56]; $p < 0.00001$, NNT=5.1).

Conclusions More investigations are needed to develop and evaluate effectiveness of injury prevention strategies tailored for FG.

444 ATHLETE PERCEPTIONS OF INTENTIONAL INJURY (ABUSE): A QUALITATIVE STUDY ACROSS THREE COUNTRIES

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Background Para athletes from less-resourced countries have the highest need for protection against abuse in sport; however, their experiences and perceptions of abuse have not been studied.

Objective To describe Para athletes' experiences and perceptions of abuse in sport, and systematically investigate the sociocultural drivers of those perceptions to inform culturally-relevant strategies to better protect vulnerable athletes.

Design Qualitative data were collected in the form of focus groups with Para athletes from Ghana, Brazil, and India. Data were analyzed using the Framework Method for Multidisciplinary Qualitative Analysis and transcripts were coded and analyzed by the research team.