Appendix 4. Summary of Data Extracted from Included Studies

Study Features (author, year, design, country)	Participants (sport, level, sex, age, sample size)	Outcome (definition and ascertainment)	Injury estimate	Exposure (Risk factor(s)	Reported as significant risk factor(s)	Reported statistics	Reported non-significant risk factor(s)	DB score (/23)^	Level of Evidence
Azzam et al., 2015[18] Historical Cohort United States	Professional Basketball Players Male = 34 Age = not reported n = 34 (17 injuries)	Injury = traumatic or overuse MSK event resulting from basketball that led to time loss of ≥7 days from practice and/or games. Ascertained by ATC	50% of players experienced an injury over the 2008-2011 seasons	*Movement Quality* • DS • HS • ILL • SM • ASLR • TSPU • RS • FMS total ≤ 14 *Other* • Minutes/game • Total games	1. Higher HS score	1. p<0.001*	• DS • ILL • SM • ASLR • TSPU • RS • FMS total score ≤ 14	9	4
Bardenett et al., 2015[19] Cohort United States	High School Athletes (multiple sports) Male = 77 Female = 97 Mean age (range): 15.2 (11-18) n=176 (39 injuries)	Injury = a MSK injury resulting from organized high school sport practice or competition that required medical attention (sought care from ATC, PT, physician or other health care provider) and was restricted from full participation ≥1 practice or game. Ascertained by ATC	69.5% of players experienced an injury over the 2012 fall season	*Movement Quality* • DS • HS • ILL • SM • ASLR • TSPU • RS • FMS total • FMS total ≤11, 12, 13, 14, 15, 16, 17 *Other* • Age	1. Higher ILL score 2. Lower SM score	1. p=0.02* 2. p=0.001*	• Age • DS • HS • ASLR • TSPU • RS • FMS total score • FMS total score ≤ 11, 12, 13, 14, 15, 16, 17	12	4
Bushman et al., 2015[20] Cohort United States	Military Soldiers Male = 2,476 Age range: 18-57	Injury = all inpatient and outpatient medical encounters for any overuse and traumatic injury	Any injury: 37% Overuse: 28% Traumatic 16% In the 6 months following	*Movement Quality* • DS • HS • ILL • SM • ASLR	*Any injury* 1. FMS = 0 2. BMI (≥25.0 kg/m^2) 3. DS = 0 4. HS = 0	1. RR 1.3-2.1* 2. OR 1.3 (95% CI: 1.0,1.9)* p=0.02 3. OR 1.5 (1.1,2.0)*§	• Sex • Age • Military rank • Current smoker • SM	12	4

	n = 2,476 (916 injuries)	found in a soldiers' electronic medical records with ECD-9_CM diagnostic code determined to be an injury. Overuse injuries ICD-9-CM codes 710-739 Traumatic injuries ICD-9-CM codes 800-999 Ascertained by Defense Medial Surveillance System	screening	• TSPU • RS • FMS individual test = 0 • FMS total = 0 *Other* • Sex • Age • Military rank • BMI • Current smoker	5. ILL = 0 6. TSPU = 0 7. RS = 0 *Overuse* 8. DS = 0 9. HS = 0 10. ILL = 0 11. TSPU = 0 12. RS = 0 *Traumatic* 13. HS 14. TSPU	p<0.01 4. OR 3.5 (2.1,6.0)*§ p<0.01 5. OR 2.4 (1.5,3.8)*§ p<0.01 6. OR 2.0 (1.3,3.3)*§ p<0.01 7. OR 1.7 (1.0,2.8)*§ p=0.03 8. Not reported 9. Not reported 10. Not reported 11. Not reported 12. Not reported 13. Not reported 14. Not reported	• ASLR		
Butler et al., 2013[21] Cohort United States	Firefighter trainees Sex = not reported Age: not reported n=108 (number of injuries not reported)	Injury = any episode that resulted in 3 consecutive missed days of training due to MSK pain Ascertained: Strength and conditioning staff	No injury estimate was reported for the 16 week training academy	• DS • HS • ILL • SM • ASLR • TSPU • RS • FMS total ≤14	1. Lower DS score 2. Lower TSPU score 3. FMS total ≤ 14	1. OR 1.2 (1.0,1.4)* 2. OR 1.3 (1.1,1.5)* 3. OR 8.31 (3.2,21.6)* SEN: 0.83 SPE: 0.62 PLR: 2.2 NLR: 0.26	• HS • ILL • SM • ASLR • RS	8	4
Chorba et al., 2010[22] Cohort United States	NCAA Division II collegiate athletes Female = 38 Mean age (SD): 19.2±1.2 n=38 (18 injuries)	Injury = a MSK injury resulting from organized intercollegiate sport practice or competition that required medical attention or advice from an ATC, AT student or physician.	47% of players experienced an injury over the 2007-2008 season	• FMS total ≤14	1. FMS total ≤ 14	1. OR 3.85 (0.98,0.15.1) p=0.05 SEN = 0.58 SPE = 0.74	n/a	9	4

		Ascertained: ATC							
Dossa et al., 2014[31] Cohort Canada	Junior hockey players Male = 20 Mean age (range): 18.2 (16-20) n=20 (17 injuries)	Injury = a physical condition which occurred during a game or practice which resulted in the player missing ≥1 game. Contact = involved collision with another body, ice, boards, puck or stick. Non-contact = not a contact injury Ascertained: ATC	85% of players experienced an injury over the 2013-2014 season (76 games)	• FMS total ≤14	n/a	n/a	• FMS total ≤14 SEN: 0.5 (0.2,0.8) SPE: 0.7 (0.3,0.9) PLR: 1.7 (0.6,5.2) NLR: 0.7 (0.2,0.9)	12	4
Garrison et al., 2015[23] Cohort United States	NCAA Division I collegiate athletes Sex = not reported Age range: 17-22 n=160 (52 injuries)	Injury = any MSK pain complaint associated with athletic participation, that required consultation with an ATC, PT or MD and resulted in modified training for ≥24 hours or required protective splinting or taping for continued participation Ascertained: ATC	32.5% of players experienced an injury over the season	*Movement Quality* • FMS total • FMS total ≤14 • Prior injury + FMS total ≤14 • FMS total ≤13 • Prior injury + FMS total ≤13 *Other* • Prior injury	1. Prior injury 2. FMS total 3. FMS total ≤14 4. Prior injury + FMS total ≤14 5. FMS total ≤13 6. Prior injury + FMS total ≤13	1. OR 3.45 (1.7,7.0)* 2. p=<0.05 3. OR 5.61* (2.7,11.5) 4. OR 15.11* (6.6,34.6) 5. OR 9.52* (4.1,21.8) 6. OR 11.86* (4.1,34.2)	n/a	8	4
Hotta et al., 2015[33] Cohort Japan	Collegiate track and field athletes Male: 84 Mean age	Running injury = a MSK injury that occurred during participation in track and field practice or competition that	17.9% of runners experienced an injury over a 6 month season	*Movement Quality* • DS • HS • ILL • SM • ASLR • TSPU	1. Lower DS score 2. Lower ASLR score 3. DS+ASLR score ≤ 3	1. p=0.01* 2. p<0.01* 3. OR=9.7 (2.1,44.4)*§ p<0.01	• HS • ILL • SM • TSPU • RS • FMS total ≤14 • Age	14	4

	(range): 20.0 (18-24) n= 84 (15 injuries)	prevented participation for 4 weeks. Ascertained: not reported		• RS • FMS total ≤14 *Other* • Age • Height • Weight • Running experience • Weekly training sessions • Weekly mileage • Performance level • Prior injury			• Height • Weight • Running experience • Weekly training sessions • Weekly mileage • Performance level • Prior injury		
Kiesel et al., 2007[24] Cohort United States	Professional American football players Sex = not reported Age = not reported n=46 (13 injuries)	Injury = on the injury reserve list and a time loss of ≥3 weeks. Ascertained: not reported	28.3% of players experienced an injury over the season	• FMS total • FMS total ≤14	1. Lower FMS score 2. FMS total ≤14	1. p<0.05* (t=5.62) 2. OR 11.67* (2.5,54.5) SEN: 0,54 (0.3,0.7) SPE: 0.91 (0.8,0.96) PLR: 5.92 (2.0,18.4) NLR: 0.51 (0.3,0.8)	n/a	7	4
Kiesel et al., 2014[25] Cohort United States	Professional American football players Sex = not reported Age = not reported n=238 (60 injuries)	Injury = MSK injury resulting in time loss from preseason practice or games. Ascertained: Sports medicine staff	25% of players experienced an injury over the preseason	• FMS total • FMS asymmetry • FMS total ≤14 • Asymmetry +FMS total ≤14	1. FMS total 2. FMS asymmetry 3. FMS total ≤14 4. Asymmetry + FMS total ≤14	1. p=0.02* 2. RR 1.80 (1.1,2.7)* SEN: 0.58 (0.5,0.7) SPE: 0.62 (0.6,0.7) 3. RR 1.87 (1.2,3.0)* SEN: 0.26 (0.2,0.4) SPE: 0.87 (0.8,0.9)	• Asymmetry + FMS total ≤14 (not reported)	8	4

Knapik et al., 2015[26] Historical Cohort United States	Coast Guard cadets Male = 770 Female = 275 Mean age (SD) Male: 18.1 (0.7) Female: 17.9 (0.7) n=1,045 (number of injuries not reported)	Injury = any physical bodily damage resulting in a clinic visit which was suspected to be caused by cadet training. Ascertained: PT and other health care providers	Male = CII 18.6% Female = CII 24.7% For candidates attending classes between 2004-2007	• FMS total ≤9 • FMS total ≤10 • FMS total ≤11 • FMS total ≤12 • FMS total ≤13 • FMS total ≤14 • FMS total ≤15 • FMS total ≤16 • FMS total ≤17 • FMS total ≤18 • FMS total ≤19 Calculated for males and females separately	*Males* 1. FMS total ≤9 2. FMS total ≤10 3. FMS total ≤11 *Females* 4. FMS total ≤9 5. FMS total ≤10 6. FMS total ≤11 7. FMS total ≤12 8. FMS total ≤13 9. FMS total ≤14 10. FMS total ≤15	*Males* 1. RR 1.63 (1.1,2.4) p=0.02* 2. RR 1.73 (1.2,2.5) p<0.01* 3. RR 1.64 (1.2,2.3) p<0.01* SEN: 0.22 SPE: 0.87 *Females* 4. RR 1.91 (1.2,3.0) p<0.01* 5. RR 1.81 (1.2,2.8) p=0.02* 6. RR 1.85 (1.1,2.7) p=0.02* 7. RR 1.66 (1.1,2.6) p=0.03* 8. RR 1.83 (1.2,2.7) p<0.01* 9. RR 1.93 (1.2,3.0) p<0.01* SEN: 0.60 SPE: 0.61 10. RR 1.97 (1.2,3.2) p<0.01*	*Males* • FMS total ≤12 • FMS total ≤13 • FMS total ≤14 • FMS total ≤15 • FMS total ≤16 • FMS total ≤17 • FMS total ≤18 • FMS total ≤19 *Females* • FMS total ≤16 • FMS total ≤17 • FMS total ≤18 • FMS total ≤19	9	4
Lisman et al., 2013[27] Cohort	Marine Corps Officer Trainees Male = 874	Any Injury = sought medical care ≥1 times during training due to physical	Not reported (6 or 10 week training)	*Movement Quality* • FMS total ≤14 *Other*	*Any Injury* 1. Prior injury 2. Longer training 3. Slower RT	*Any Injury* 1. OR 1.41 (1.1,1.9)* p=0.02 2. OR 1.49	• Baseline running frequency ≥5 • Baseline	15	2b

United States	Mean age (SD): 22.4±2.7 n=874 (number of injuries not reported)	bodily damage resulting from training Overuse = sought medical care for presumed long-term repetitive energy exchanges that led to cumulative micro-trauma Traumatic = sought medical care for acute or sudden energy exchanges leading to abrupt overload and tissue damage Ascertained: Health care providers		• Prior injury • Baseline GES frequency ≥5 • Baseline running frequency ≥5 • Run history • Baseline weight training frequency ≤1, 2-4 ,≥5 • Training length (6 or 10 weeks) • PU ≥17 • AC ≥100 • RT ≥20.5	4. FMS total ≤14 *Overuse* 5. Less GES 6. Longer training 7. Slower RT *Traumatic* 8. Less running history 9. Longer training 10. Slower RT 11. FMS total ≤14	(1.1,2.0)*§ p=0.009 3. OR 1.74 (1.3,2.4)*§ p<0.001 4. OR 2.10 (1.3,3.3)*§ p=0.001 *Overuse* 5. OR 1.78 (1.1,2.9)*§ p=0.014 6. OR 1.6 (1.0,2.6)* p=0.32 7. OR 1.65 (1.0,2.6)* p=0.032 *Traumatic* 8. OR 2.07 (1.1,3.9)* p=0.023 9. OR 1.47 (1.1,2.0)*§ p=0.021 10. OR 1.64 (1.2,2.3)*§ p=0.003 11. OR 1.80 (1.1,2.9)*§ p=0.015	weight training frequency • PU ≥17 • AC ≥100		
Padua et al., 2015[28] Cohort United States	Elite youth soccer players Male = 348 Female = 481 Mean age (SD, Range): 13.9 (1.8, 11-18)	Injury = ACL tear verified at surgical reconstruction Non-contact = no direct contact to the LE by an external force Indirect-Contact =	0.8 % of players experienced an ACL tear over 2006-2009 seasons IRR = 0.006 (0002,0.012)	• LESS total • LESS ≥5	1. Higher LESS total 2. LESS ≥5	1. t=-2.78, p< 0.005* 2. RR 10.7 SEN: 0.86 (0.42, 0.99) SPE: 0.65 (0.62,0.67) PPV: 0.01 (0.006,0.03)	n/a	11	2b

	n=829 (7 injuries)	contact with a body part other than the knee Ascertained: self-report verified by surgeon				NPV: 0.998 (0.991,0.999)			
Shojaedin et al., 2014[32] Cohort Iran	Competitive or recreational university athletes Male = 50 Female = 50 Mean age (SD; range): 22.6 (3.0; 18-25) n=100 (35 injuries)	Any injury = not reported Knee injury = not reported Ankle injury = not reported	35% sustained injury during the season	• FMS total • FMS score <17	*Any injury* 1. FMS total 2. FMS total <17 *Knee Injury* 3. FMS total <17 *Ankle Injury* 4. FMS total <17	*Any Injury* 1. p=0.005 2. OR 4.70 (no p-value or 95%CI reported) SEN: 0.65 SPE: 0.78 PLR: 2.46 NLR: 0.62	• FMS total <17 for knee and ankle injury	3	4
Smith et al., 2012[34] Case-control (embedded in a cohort) United States	High school and college athletes Male = 29 Female = 73 Mean age (SD): 18.3 (2) n= 92 (28 injured)	Noncontact ACL tear = ACL tear resulting from a non- knee contact event with another athlete, ground, or extraneous structure Ascertained: orthopedic surgeon, MRI and surgery	30.4% of athletes sustained an injury over 1 season	• LESS total • LESS ≤ 4 • LESS >4- ≤5 • LESS >5 -≤6 • LESS >6	• n/a	• n/a	• LESS total • LESS ≤ 4 • LESS >4- ≤5 • LESS >5 -≤6 • LESS >6	14	3b
Warren et al., 2015[29] Cohort United States	NCAA Division 1 collegiate athletes Male = 89 Female = 78 Age range: 18-	Injury = First non-contact MSK problem that resulted in medical intervention. Non-contact injury: non-contact	44% of athletes experienced an injury over the competitive season	*Movement Quality* • DS • HS • ILL • SM • ASLR • TSPU • RS • FMS total	1. Female sex 2. Older age 3. Lower BMI 4. ILL = 2	1. p=0.003* 2. p=0.006* 3. p=0.006* 4. OR 0.21*§ (0.08,0.59)	1. Prior injury 2. Sport 3. DS 4. HS 5. SM 6. ASLR 7. TSPU 8. RS 9. FMS total	11	4

	24 n= 167 (74 injuries)	mechanism Contact injury = contact mechanism Ascertained: ATC		• FMS total ≤10 • FMS total ≤12 • FMS total ≤14 • FMS total ≤16 • FMS total ≤18 • Asymmetry of 5 bilateral FMS tests *Other* • Prior injury • Sex • Age • BMI • Sport			10. FMS total ≤10 11. FMS total ≤12 12. FMS total ≤14 13. FMS total ≤16 14. FMS total ≤18 15. Asymmetry of 5 bilateral FMS tests		
Wiese et al., 2014[30] Cohort United States	NCAA Division 1 collegiate American football players Sex: not reported Mean age (SD): 18.9 ± 1.3 n = 144 (93 injuries)	Injury = initial MSK problem arising from organized training or game requiring medical attention and restricted participation for ≤1 days LE injury = groin – toes Overuse injury = tendinopathy, muscle spasm, tightness or soreness Non-contact injury = non-contact mechanism Injury >10 days Ascertained: ATC	65% of players experienced an injury over 1 season 52% LE 39% overuse 42% noncontact 20% >10 days	• FMS total • FMS total ≤12 • FMS total ≤17 • FMS total ≤18	• n/a	• n/a	• FMS total • FMS total ≤12 • FMS total ≤17 • FMS total ≤18	10	4

*Statistically significant $p<0.05$, [§]Multivariable analyses, [⌘]Estimated from reported injury incidence, [+]analyses did not account for matched design, ^Maximum Downs and Black Score for prospective cohort study = 23, while the maximum score for a randomized control trail is 33, AC = abdominal crunch, ASLR = active straight leg raise, ATC = certified athletic trainers, BMI = body mass index (kg/m^2), CI = confidence interval, DB = Downs and Black Score, DF = dorsiflexion, DS = deep squat, FMS = Functional Movement Screen, GES = general sport and exercise, HR = Hazard ratio, hrs=hours, HS = hurdle step, ICD-9-CM = International Classification of Disease, Ninth Revision, Clinical Modification, ILL = in-line lunge, IR = incidence rate, IRR = incidence rate ratio, LE = lower extremity, LESS = Landing Error Scoring System, LOE = level of evidence, n/a = not applicable, MD = medical doctor, MSK = musculoskeletal, n/a = not applicable, NLR = negative likelihood ratio, OR = odds ratio, PLR = positive likelihood ratio, PT = physical therapists, PU = pull ups, ROM=range of motion, RR = risk ratio, RS = rotary stability, RT = 3-mile run time, SD = standard deviation, SLHB = single leg hamstring bridge, SLR = straight leg raise, SM = shoulder mobility, TOP = tenderness on palpation, TSPU = trunk stability push-up, TXHD = triple cross-over hop for distance, UE = upper extremity, VDJ = vertical drop jump, wks = weeks, YBT = Y-balance test, yrs = years.