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Appendix A. Summary of Studies Cited to Develop Grades of Recommendation

Study	Level of Evidence*	Summary	Outcome
Effect of sports on musculoskeletal function			
Baik et al[23]	II	RCT n=16 12wk horseback riding program vs normal rehab activities in children with CP	Improvements in muscle tone and hip range of motion for intervention group, not in control group. However, groups were not significantly different from each other at follow-up.
Chin et al[87]	II	Prospective comparative n=24 6 wks of endurance cycling with the contralateral leg in people with unilateral transfemoral amputations vs ordinary prosthetic walking training	Maximal oxygen consumption and anaerobic threshold significantly increased in intervention group compared to control
Dodd et al[20]	II	RCT n=21 6wk home-based strength training program vs normal daily activities in young adults with spastic diplegic CP	Increased lower limb strength as measured by dynamometer at 6 and 12wks following intervention. Trend towards faster walking speed and improved scores on Gross Motor Function Measures of Standing, Walking/Running/Jumping but not statistically significant

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Herrero et al[29]	II	RCT n=38 10wk of hippotherapy simulation sessions with simulator turned on vs simulator turned off (no rhythmic movement) in children with CP	Sitting balance significantly improved in intervention group and improvements were larger for children with lower functional levels. However, gains were not maintained at 3-month follow-up
Hemachithra et al[25]	II	RCT n=35 1 session of hippotherapy simulation vs sitting on a pillow for same amount of time in children with GMFCS I-III CP	Significant reduction in adductor spasticity and hip abduction range of motion in intervention group. No long term follow-up.
Pitetti et al[86]	III	Prospective n=10 15wk aerobic conditioning program in adults with lower extremity amputations	Heart rate during rest and exercise, and oxygen consumption decreased after intervention
Sterba et al[31]	III	Prospective n=17 18wks of horseback riding in children with spastic CP	Significant improvements in Gross Motor Function Measure total score that persisted at 6wks post-intervention. Improvements in dimensions of walking, running, jumping remained longer than 6wks following intervention.
Lakes et al[32]	III	Prospective n= 8 6wk of ballet classes in children with spastic, ambulatory CP	Significant improvements in step length on right, stride length on left, and ambulation speed 5wks after intervention
Vega et al[48]	IV	Cross sectional	

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		n=11 Assessed level of neurotrophic factors after moderate intensity hand-biking in athletes with SCI	Significant elevations in brain-derived neurotrophic factor (BDNF) at baseline in elite athletes with SCI and after 10 minutes of hand-biking. BDNF promotes synaptic plasticity and neurogenesis
Dallmeijer et al[50]	IV	Prospective n=20 Adults with SCI followed for 1 year after discharge from acute rehabilitation center. High lost to follow-up rate	Participation in at least 1hr of sports activity/week was most important variable explaining increases in physical capacity (sprint and power output) at 1 year follow-up
Bragaru et al[80]	IV	Systematic review n= 47 studies Studies examining sports participation among amputees	Cardiopulmonary function improved in people with amputations engaged in regular exercise programs
Kurdiballo & Bogatykh[89]	IV	Prospective n= not listed Swimming and underwater exercise program in people with lower limb amputations	Reduced blood pressure and body mass after swimming exercise program
Lopez-Ortiz et al[24]	IV	Systematic review n= 11 studies Studies examining rehabilitative effects of dance in people with CP	Preliminary evidence of benefits of dance on balance, gait, walking, and cardiorespiratory fitness but studies of too varied methodology and without validated outcome measures to make definitive conclusion
Ross et al[13]	IV	Retrospective n=97 Intensive summer sports program for people with CP GMFCS I-III, ages 6-	Significant improvements in Timed Up and Go, 25ft walk/run, and modified 6-min walk distance over time, representing

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		20. Subjects participated each summer (maximum of 4 weeks) over 9 years	improved walking ability and endurance
Injuries in Para Athletes			
Burnham et al[49]	II	Prospective comparative n= 39 SCI wheelchair athletes vs able bodied controls who underwent shoulder muscle strength testing	SCI athletes had stronger shoulder muscles than controls. SCI athletes with RTC impingement were weaker in adduction, ER, and IR than SCI athletes without impingement.
Chung et al[39]	II	Prospective comparative n=24 Wheelchair fencers vs able bodied fencers competing on Hong Kong National Squad followed over 3 years	Wheelchair fencers had increased relative risk of injury compared to able-bodied fencers: RR 13.6 for shoulder injury, RR 5.9 for elbow injury, 2.2 for muscle strains. Wheelchair fencers with poor trunk control had higher RR of injury than those with good trunk control
Akbar et al[61]	III	Cross sectional comparative n=296 Wheelchair users with SCI who play overhead sports regularly vs those who don't play overhead sports regularly	Regular overhead sports players had significantly increased risk of RTC tear: Overall RR 2.2. RR 2.3 in individuals with higher neurological level of lesion
Blauwet et al[34]	III	Prospective n= 977 Athletes competing in track and field followed over 10-day competition period at 2012 Paralympic Games	Majority of ambulant athletes sustained injuries to the thigh and majority of athletes using a wheelchair sustained shoulder or clavicle injuries. Less injuries among ambulant athletes

			with CP compared to athletes with visual impairment or limb deficiency
Nyland et al[96]	III	Cross sectional n= 304 U.S. athletes competing at 1996 Paralympic Games	254 soft tissue injuries identified. Upper extremity injuries most common in wheelchair athletes. Increased rates of contralateral ankle injuries in unilateral amputees.
Webborn et al[37]	III	Prospective n= 166 Football 5-a-side and 7-a-side athletes followed over competition at the 2012 Paralympic Games	IP of 31.4 injuries/100 athletes for football 5-a-side and 14.6 injuries/100 athletes for football 7-a-side
Willick et al[15]	III	Prospective n= 3,565 Athletes from 160 delegations followed over competition at the 2012 Paralympic Games	Overall IP was 17.8 injuries/100 athletes. Predominance of upper limb injuries, particularly involving shoulder. Acute traumatic injuries accounted for 51.5%, chronic overuse for 31.8%, acute on chronic for 16.7%. Injury rates for women were higher in the pre-competition period compared to competition period.
Derman et al[38]	III	Prospective n= 547 Athletes from 45 countries followed over competition at the 2014 Paralympic Games	IR was 26.5/1000 athlete days. IR was 3x higher than in 2014 Olympic games and 2x higher than 2012 summer Paralympic games. Sports with highest IR were skiing/snowboarding and para ice hockey.

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Webborn et al[40]	III	Prospective n=505 Athletes from 44 countries followed over competition at the 2010 Paralympic Games	Injuries identified in 24% of athletes, higher rates than in 2002 and 2006. Injury rates highest in alpine skiers and para ice hockey athletes
Webborn et al[41]	III	Prospective n=39 Athletes from 20 countries followed over competition at the 2002 Paralympic games who presented to the village clinic	39 injuries identified. Alpine skiers most frequently injured athletes (62% of total injuries), followed by para ice hockey (31%). 77% injuries were acute traumatic. 27% were severe enough to affect participation. 18% were due to equipment issues
Hawkeswood et al[42]	IV	Cross sectional n= 10 Survey of trainers, therapists, physicians and coaches from top 5 international para ice hockey teams	Upper extremity injuries (muscle strains, lacerations) and concussions were most common. Suggestions for improved hand protection, reduction in intentional head contact, lowered-rink boards, and modified rink bathroom surfacing
Athanasopolous et al[36]	IV	Retrospective n=161 Athletes who presented for care at the 2004 Paralympic Village physiotherapy clinic	131 injuries identified. Most injuries to the upper extremity among wheelchair athletes. Acute injuries: 64.1%, Overuse injuries: 22.1% Most injuries occurred pre-competition
Heneghan et al[91]	IV	Retrospective n= 32 Paralympic athletes with limb deficiency seeking	107 lower back injuries identified. Most injures occurred during training and located in lumbosacral

		care at the English Institute for Sport from 2008-2017	region. Increased training volume and equipment issues associated with lower back problems
Heneghan et al[95]	IV	Retrospective n=34 Paralympic athletes with limb deficiency seeking care at the English Institute for Sport from 2008-2016	162 upper limb injuries identified. Most commonly located in shoulder, neck, and thorax, particularly in athletes with upper extremity amputations.
Abuse in Parasport			
Vertommen et al[102]	III	Cross sectional comparative n= 4,000 total, n= 185 in parasport 4,000 European adults surveyed who participated in organized sport as a child	Among those who participated in parasport, 49.7% reported psychologic abuse, 32.4% physical abuse, 33.5% sexual abuse. Compared to children in able bodied sports, RR 2.9 of sexual abuse, 3.23 of physical abuse, 1.39 of psychologic abuse
Tukali-Wosornu[101]	IV	Systematic review n= 8 Studies examining harassment and/or abuse in athletes with physical or emotional impairments	Half of studies described high rates of bullying and its social implications. Most studies focused on young, visually impaired athletes. Concluded that there is limited amount of data to estimate true prevalence of non-accidental harm in para athletes
Rutland et al[103]	IV	Cross sectional n= 27 Qualitative survey data from interviews conducted with para athletes	Athletes identified wide range of abusive behaviors with 3 types identified more frequently and were less easily recognized:

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			financial abuse, neglect, and disability stigma
Injury/Illness Prevention			
Belanger et al[72]	II	Prospective comparative n= 28 Subjects with SCI who underwent functional electrical stimulation (FES) resistance training program on 1 limb, FES against gravity on other limb, and matched control group without SCI	After FES training, subjects with SCI regained 30% of the bone lost in the distal femur and proximal tibia. Rate of increased bone mass was quicker in the limb undergoing FES with resistance training
Nawoczenski et al[76]	II	Prospective comparative n= 41 8wk home exercise program in wheelchair users with SCI with shoulder pain vs. asymptomatic controls	Intervention group showed significant improvements in pain reduction, function, and satisfaction, whereas asymptomatic control group remained stable
Yildirim et al[77]	II	RCT n= 26 6wk upper extremity circuit resistance training (CRT) program vs conventional rehabilitation in people with SCI	CRT had positive effects on upper extremity strength and the physical disability component of the Functional Independence Measure (FIM), with no significant improvement in quality of life scores.
Murphy et al[98]	IV	Case series n=5 Outcomes in children who underwent osteocartilagenous capping of a residual limb. Mean follow-up 6.5 years	All bone flaps survived. No development of bone spiking. All patients had bony union. One patient required additional debridement of partial flap necrosis
Shimizu et al[80]	IV	Cross sectional n= 22	Deep tissue injuries in sacrum and ischium found

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		Female wheelchair basketball players on Japanese national team	in 62% of players. More frequent in those with central nervous system disease vs musculoskeletal system disease, use of wheelchair in daily life, lower blood pressure and lower creatinine
Zleik et al[68]	IV	Systematic review n= 226 Studies examining prevention of osteoporosis and fractures in persons with SCI	7/10 studies evaluating exercise as preventative tool found improved bone mineral density with exercise. However, studies too varied to determine most beneficial type and duration of exercise. Bisphosphanates improved bone density in all but one study.

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