Evidence-Based Strength and Conditioning Plan for Freestyle Snowboarding Athletes

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ABSTRACT

Competitive snowboarding (SB) has rapidly grown in popularity since its introduction into the Olympics in 1998. This growth has seen a significant increase in trick difficulty and the associated physical demands required for success. Despite the increase in physical requirements, there are currently no evidence-based recommendations that incorporate strength and conditioning or injury prevention programs. This article draws on current research that details the physical demands of SB and integrates relevant strength and conditioning principles to create an evidence-based training plan. This plan highlights the essential physical attributes for snowboard athletes that are important for successful performance and mitigating injury risk.

INTRODUCTION

Since its introduction into the Olympics, competitive snowboarding (SB) has seen rapid growth in popularity, trick innovation, and overall performances. Slopestyle SB has become a popular discipline and involves athletes performing multiple aerial tricks, while also completing maneuvers over purpose-built features including rails, boxes, tubes, and half-pipes. Due to the diversity of activities in this event, athletes require a range of physical attributes to maximize performance and reduce injury risk (37,49,50).

There is an increasing demand for evidence-based strength and conditioning interventions for snowboarders, yet there are currently no well-defined sport-specific training options for performance coaches. A systematic review providing injury-prevention recommendations for snow sports examined 32 articles and noted that there were no published articles that recommended physical fitness or training as injury-prevention strategies for snowboarders (21). Research has briefly discussed the physiological demands for SB (37,49,50); however, integration of this information into a strength and conditioning plan has yet to be completed. This article aims to bridge this gap by addressing the fundamental physical demands of competitive SB and present a training program to develop the respective attributes. It is designed as a template for SB athletes and coaching staff to improve athletic performance and reduce the likelihood of injury. The following sections in this article explore each of the essential physical demands of SB (Figure 1). These physical demands will then be integrated into a sample training plan, including a detailed overview of various prescription and programming strategies for strength and conditioning coaches.

PHYSICAL ATTRIBUTES

MUSCULAR STRENGTH

Developing full-body muscular strength in SB athletes may increase scoring potential while also developing the robustness required for the sport's physical demands. Currently, there is no evidence to show that superior levels of maximal strength correlates with better on-snow performance, however, similar sports such as surfing have shown the importance of strength on performance (29,42–44,46). Lower-body eccentric strength (37,49,50), rate of force development (RFD) (36,49,50), quadriceps and trunk strength (49,50), rotational and antirotational strength (49), and upper-body pulling strength (31,49) have all been identified as essential types of strength for SB athletes.

Lower-body eccentric strength should be included as a significant component of SB athletes' injury-prevention plan to assist with landing mechanics and

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snowboarding; strength and conditioning; training plan; freestyle; adventure sport

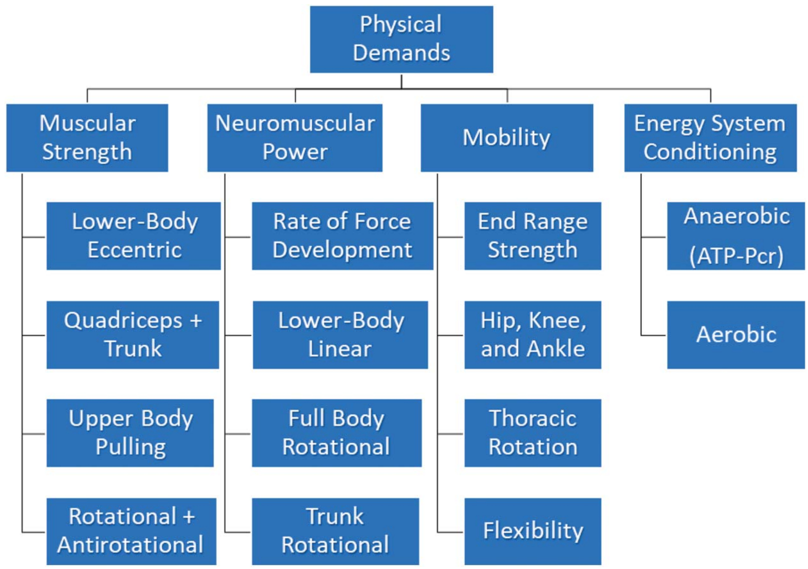

Figure 1. Deterministic model of essential physical demands for freestyle snowboarding athletes.

the ability to absorb forces associated with landing aerials. Despite no current reports of ground reaction forces (GRF) from aerials in SB (17), research has shown that skateboarders absorb GRF 4–5 times their body weight after a 50-cm jump. Because SB athletes are required to land aerials upward of 3 meters in height (as seen in Figure 2), it is reasonable to assume that they too must be robust to absorb the large eccentric GRF associated with landing (33). Riding features such as rails, boxes, and tubes also require a significant amount of lower-body eccentric strength due to the joint angles and postural adjustments in the approaching, riding, and exiting phases of these features. This frequent exposure to high loads of eccentric force demonstrates the importance of eccentric strength and elastic tissue properties at the hip, knee, and ankle joints. The physical characteristics of landing in SB have also been related to the common drop jump and countermovement jumping (CMJ) tasks (25,51). Factors such as muscle-tendon stiffness, muscle activation patterns, and neural drive are important factors for the successful execution of these movements (33,38). It is therefore reasonable to suggest that these qualities would also be favorable in SB athletes. An increase in muscle-tendon stiffness and motor unit recruitment has been shown to significantly improve jumping performance (1). These tissue properties are often improved through eccentric resistance training and therefore highlight the importance of incorporating eccentric training into a snowboarder's training plan.

Figure 2. Aerial jump in freestyle run (credit: Red Bull content pool).

Due to the high incidence of knee and shoulder injuries in SB, quadriceps and upper-body pulling strength have been identified as important factors for SB athletes (2,48). The quadriceps play a significant role in the eccentric force transfer and distribution during successful landing mechanics. Therefore athletes who have underdeveloped or weak quadriceps may compromise the integrity of their landings and increase the likelihood of injury. The quadriceps have also been identified as an important contributor toward the overall forces applied during the regular riding stance of competitive snowboarders (15). Developing quadriceps strength will therefore help minimize fatigue during the basic riding phases and allow optimal force absorption when completing "big air" landings. Shoulder dislocation has been identified as one of the leading injuries in freestyle SB (3,49). The mechanism of injury is often attributed to blunt force trauma to the glenohumeral joint as a result of falling from an aerial (49). Therefore, creating robustness through strengthening the structures of the shoulder may increase the athlete's tolerance to blunt force trauma and reduces the risk of injury.

For most cases, strength and conditioning coaches should develop plans to minimize hypertrophy adaptations and possibly avoid hypertrophy-specific training altogether. Increased body mass has been associated with greater stress placed on joints and reduced kinesthetic feedback during landings (12,13). An increase in body mass has also been associated with a reduced ability to perform air rotations, often due to a reduction in jump amplitude (41). Given the potential to be detrimental to performance, it is recommended that the training plan include only a small volume of hypertrophy training early in preseason to promote a small amount of muscle growth, which can increase overall strength, without adding unnecessary mass. An exception may be appropriate for light and/or underweight athletes who struggle with clearing aerial jumps. A purposeful increase in muscle mass in the preseason may assist these athletes with achieving the speeds necessary to clear large jumps and negotiate strong winds and difficult snow conditions.

NEUROMUSCULAR POWER

The nature of competitive SB relies heavily on the neuromuscular system and involves high volumes of explosive and high-velocity movements (18,37,39,49,50). RFD is an important factor in the take-off and landing phases of "big air" jumps in addition to contributing to the successful completion of maneuvers on features. Also, RFD may transfer to the many small body and board adjustments required to ensure a controlled entry and take-off for each trick. However, there is currently no available evidence detailing the importance of RFD production and potential transfer to SB performance. The prescription and programming of resistance training sessions in Tables 3 and 4 aims to develop RFD. This can been be achieved by educating SB athletes on how to perform each movement with maximal intent and prescribing short sets to maximize the quality of each repetition. Shortening sets and understanding how to move the bar with intent will promote fast and quality repetitions, which in turn will increase RFD (22). Another strategy to increase RFD is to incorporate short bouts of plyometric training into the warm-up for each strength and skill session. Exercises such as bounding, stiff-leg jump, single-leg bounds, and depth jumps can also be incorporated. The inclusion of these exercises will develop the athlete's acute readiness to perform. These exercises prepare the tendons and ligaments for the training session in addition to developing long term athlete development (LTAD) (6).

Lower-body power has been positively correlated with performance in elite high-performance SB athletes (39). Explosive leg strength can increase jump amplitude, prolong time in air, and allow the athlete to perform more difficult tricks, ultimately resulting in greater scoring potential. To increase trick difficulty, riders are often required to perform multiple rotations and/or flips during aerials. To perform these maneuvers, SB athletes rely on trunk rotational power to maximize the degrees of rotation while maintaining their center of mass over the center of the board (49). Due to these sport-specific demands, lower-body power and trunk rotational power should be considered when developing a training plan for competitive SB athletes. CMJ testing is commonly used to assess lower-body power and monitor neuromuscular fatigue (10,11,47). It has also been suggested that CMJ testing can be a useful monitoring tool to detect acute fatigue and training adaptations in SB athletes (18). Given the importance of lower-body power in competitive SB, incorporating CMJ testing could provide valuable feedback for periodization and injury-prevention purposes.

MOBILITY

There is currently no evidence to suggest an optimal degree of mobility or flexibility for SB athletes. Regardless, the athletic benefits of incorporating mobility sessions should be considered in the training plan to ensure adequate range of movement (ROM) for the sport-specific requirements (20). Furthermore, it is evident that athletes require high amounts of end-range strength throughout their ROM for successful performance. To increase scoring potential in SB events, athletes are required to perform grabs and maneuvers that involve maintaining vulnerable body positions while performing multiple rotations and/or flips in the air (40). Successful completion of these tricks requires a high ROM and significant end-range strength in thoracic rotation and at the ankle, knee, and hip joints. Findings have also suggested that ankle joint ROM in particular may be an important factor in determining ligamentous injury risk sustained from aerial landings (4,28,30). Consequently, it is recommended that exercises targeting an increase in end-range strength, ROM, joint strength, ligament stability, and transferrable muscle activation patterns should be included in the training program (45).

ENERGY SYSTEM CONDITIONING

SB athletes typically complete high volumes of weekly training and are therefore likely to already possess a sufficient anaerobic and aerobic capacity (49). Despite this, there is currently no available evidence to suggest that superior aerobic or anaerobic capacity leads to improved SB performance. Due to the already high-volume nature of SB training plans and the frequency of consecutive training days, the amount of conditioning-specific training may be limited. Until further research determines the competitive advantage of possessing higher aerobic and/or anaerobic capacities, it is likely that the stimulus from skills and slopes training will promote sufficient adaptations for competition requirements.

Some studies suggest there is large variability within the typical training behaviors during on-slopes skill sessions (37,49). It has been reported that the typical duration of training lasts between 3 and 5 hours and includes a combination of free-riding, aerial, half-pipe, and park feature practice (37). Reports of high blood lactate levels and heart rates (HR) up to 92% of predicted maximal HR suggest there is a high anaerobic nature to these on-snow training sessions (26). This seems to reflect competition demands as a typical run will last for 30–60 seconds (49). By contrast, athletes are also commonly faced with hiking between runs and lengthy hikes to off-piste locations, which may contribute toward aerobic conditioning (37). It is therefore recommended that if an athlete presents poor signs of aerobic conditioning, small bouts of aerobic and/or anaerobic specific training may be required in the program. Exercise selection should be based on athlete engagement and enjoyment, which may include hiking, bike-riding, freestyle parkour, or off-piste powder riding sessions.

It is common for elite SB athletes to participate in training sessions and competitions at high altitudes (8). The change in air density and reduction in air resistance found at high altitudes can significantly affect the performance of sports that demand high velocities, technical skill, and aerial maneuvers (34). It is recommended that athletes complete practice sessions at altitude before a competition to allow them to become familiar with the changes in projectile motion expected during competition. Aerobic exercise performance has also been shown to be affected at altitude due to the change in partial pressure of oxygen and the individual response during acclimatization (7). To account for this, it is recommended that a minimum of 3–5 days is spent at altitude before competition, regardless of the original training environment. Collectively, these factors should be considered when dealing with athletes who are exposed to varying levels of altitude to maximize their training and competition outcomes.

STRUCTURE OF PLAN

The following annual plan (Table 1) details typical competition periods and training behaviors of part-time, amateur, youth development, or semi-professional athletes. Training phase duration and seasonal dates will change according to the geographical location of the athlete. This plan may not be reflective of professional and elite SB athletes who compete throughout the year, often resulting in no designated offseason.

The focus of the general preparation phase should be directed towards improving general physical requirements (e.g., baseline strength, power, and mobility). The adaptations from this phase will set the foundations for the specific preparation phase where the focus can be specific to the physical demands of SB. The programming structure in the preseason follows the block training principle (23) and transitions can be seen from strength → strength/RFD → RFD/power. Programming each block to achieve its respective training target will assist in suitable development of each physical quality.

Once the competitive season begins, the program structure should be based solely around tapering and peaking for each competition. The maintenance of physical attributes is desirable; however, performance in competition should always be the number one priority. Using periodized tapering and peaking strategies will ensure that the athlete is physically prepared for each event or competition. An effective peaking strategy for SB athletes is to reduce overall training volume before competition (5,19). This can be achieved by reducing the daily volume of each physical training session in the days before competition while ensuring that training intensity and quality remains high.

It is favorable to allow SB athletes autonomy to self-prescribe training over the off-season as these athletes may partake in other freestyle sports such as skateboarding, surfing, and wakeboarding. This should be encouraged because it can be beneficial for trick creativity and physical conditioning when returning for preseason (27). Due to the uncertainty around access to training facilities and one-on-one time with coaches, it is not recommended to prescribe large volumes of training during this time.

PRESEASON

Table 2 and Figure 3 provide a summary of the sets, reps, intensity, and volume throughout each phase to best achieve their respective training targets. Figure 3 is a direct reflection of Table 2 and illustrates the changes in total repetitions and weight lifted in each session. This structure will help maximize training adaptations while minimizing risk of overtraining and overreaching (5).

RESISTANCE TRAINING

Tables 3 and 4 detail all resistance training sessions (2 per week) for the 3 months of the preseason. These sessions are targeted and appropriate for part-time, amateur, youth development, or

Table 1
Annual training plan for a part-time, amateur, or youth snowboarding athlete; each season, training phase, and training target is presented

Training week	August (1–4)	September (5–8)	October (9–12)	November	December	January	February	March	April	May	June	July
Training period	Pre-season			Season							Off-season	
Training phase	General prep	Specific prep		Maintenance + tapering + peaking							Summer break	
Training targets	Strength	Strength + RFD	RFD + Power									
Competitions					1	2	3		4	5		
Training load											N/A	

Table 2
Overview of exercise prescription and programming

	Block 1				Block 2				Block 3			
	Strength				Strength + RFD				Strength + power			
Training week	1	2	3	4	5	6	7	8	9	10	11	12
Sets	3	3	4	3	3	3	4	3	3	3	4	3
Reps	4	6	5	6	4	6	5	6	4	5	4	4
Rest	1+ min	1+ min	1+ min	1+ min	2+ mins	2+ mins	3+ mins	2+ mins	3+ mins	3+ mins	3+ mins	3+ mins
Resistance (% 1RM)	70%	75%	80%	75%	75%	80%	85%	80%	75%	80%	85%	80%
Total reps	12	18	20	18	12	18	20	18	12	15	16	12

1RM = 1 repetition maximum.

semiprofessional athletes. Training frequency and volume should be adjusted according to athlete training age and competitive status. The first session for each week is found in Table 3, whereas the second session is in the corresponding column of Table 4. A minimum of one day of rest should separate these sessions during the week.

STRENGTH PHASE

This phase should focus predominantly on developing the athlete's baseline strength and eccentric strength. As seen in Tables 3 and 4, each session is based on upper- and lower-body push and pull motor patterns, which consist of mainly full-body and compound exercises (e.g., squat, deadlift, Romanian deadlift, split squat, push-up, and pull-up). These exercises allow for effective and balanced strength development, while reinforcing transferable movement patterns.

To assist the development of lower-body eccentric strength, exercises such as Nordics and RDLs have been included in the program. Alongside this, modifications

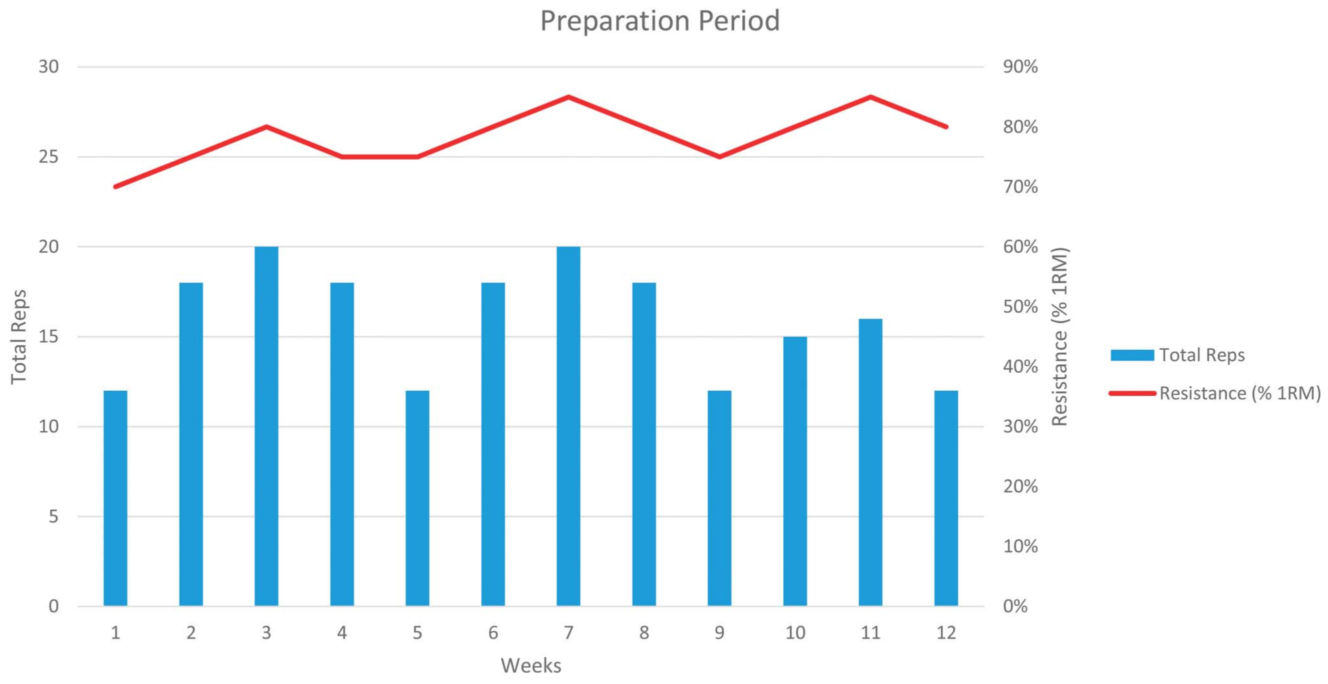

Figure 3. Overview of exercise volume (total reps) and intensity (%1RM) during the preparation period. 1RM = 1 repetition maximum.

Table 3
Resistance training (session 1)

Strength					Strength + RFD					RFD + power				
	Sets × reps, intensity					Sets × reps, intensity					Sets × reps, intensity			
Exercise	Wk 1	Wk 2	Wk 3	Wk 4	Exercise	Wk 1	Wk 2	Wk 3	Wk 4	Exercise	Wk 1	Wk 2	Wk 3	Wk 4
Trap bar deadlift	3 × 4–6 at 70%	3 × 6 at 75%	4 × 6 at 80%	3 × 4–6 at 75%	Trap bar deadlift	3 × 4 at 75%	3 × 6 at 80%	4 × 6 at 85%	3 × 6 at 80%	Trap bar deadlift	3 × 4 at 75%	3 × 5 at 80%	4 × 4 at 85%	3 × 4 at 80%
Split squat	3 × 4–6 at 2RIR	3 × 6 at 2RIR	4 × 6 at 2RIR	3 × 4–6 at 2RIR	Split squat	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Split squat	3 × 4 at 1RIR	3 × 5 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
RDL	3 × 4–6 at 70%	3 × 6 at 75%	4 × 6 at 80%	3 × 4–6 at 75%	Reverse lunge	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Pull-up	3 × 4 at 1RIR	3 × 5 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
Pull-up	3 × 4–6 at 2RIR	3 × 6 at 2RIR	4 × 6 at 2RIR	3 × 4–6 at 2RIR	RDL	3 × 4 at 75%	3 × 6 at 80%	4 × 6 at 85%	3 × 6 at 80%	Clap push-up	3 × 4 at 1RIR	3 × 5 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
Push-up	3 × 4–6 at 2RIR	3 × 6 at 2RIR	4 × 6 at 2RIR	3 × 4–6 at 2RIR	Push-up	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Med ball slams	3 × 4 at 1RIR	3 × 5 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
Stir the pot	3 × 30 s	3 × 30 s	3 × 45 s	3 × 30 s	Pull-up	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Rotation slams	3 × 4 at 1RIR	3 × 5 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
Pallof hold	3 × 30 s	3 × 30 s	3 × 45 s	3 × 30 s	Pallof hold	3 × 30 s	3 × 30 s	3 × 45 s	3 × 30 s	Russian twists	3 × 30 s	3 × 45 s	3 × 45 s	3 × 30 s

Intensity: (%) percentage of 1 repetition maximum or (RIR) reps in reserve. Number of predicted additional repetitions before exhaustion.

Tempo: Wk 1: Normal (quick concentric) Wk 2: Isometric overload (pause at end range) Wk 3: Eccentric overload (increase time under tension during eccentric phase) Wk 4: Normal.

Exercises: *Stir the Pot: Athlete assumes plank position with forearms on a Swiss ball and draws imaginary circles with arms.

to traditional compound exercises (e.g., squat, deadlift, and lunge) can be made to direct the focus to the eccentric phases of these movements. This may involve isolating the eccentric component of a trap bar deadlift (assistance with concentric phase), slowing down the tempo of the eccentric phase of a traditional front squat, or prescribing variations (e.g., reverse lunges) to increase the eccentric demand.

Due to the importance of trunk strength for SB athletes, each session incorporates 2 trunk exercises at the end. Exercise selection is aimed at developing concentric, isometric, rotational, and antirotational trunk strength. Programming a variety of trunk exercises will assist in the full development of trunk strength while also helping with engagement and enjoyment toward the end of the session.

STRENGTH AND RFD PHASE

This phase should aim to make subtle changes to the exercises, sets, rest, and tempo to promote high rates of force production. There are many similarities to the first phase, such as upper/lower and push/pull structure, inclusion of lower-body eccentric exercises, and a full-body focus. The most important change in this phase is the tempo of all major compound lifts. To increase RFD, concentric phases of lifts such as deadlift, squat, lunge, push-up, and pull-up should be completed quickly with maximal intent (35). To ensure that this is done effectively, it is important to prescribe the appropriate weight (percent of 1 repetition maximum or reps in reserve).

New exercises such as reverse lunge and walking lunge have been added to the program. These were added to deliver a greater stimulus to the quadriceps and provide a higher eccentric demand. When performed at the prescribed tempo, these exercises will require a high amount of eccentric force to the quadriceps through the lowering phase and a rapid RFD during the concentric phase.

As seen in Table 2, the prescription during this phase consists of a lower training volume while maintaining a high intensity throughout. Using the structure provided will allow the athlete to simultaneously maximize RFD, develop lower-body eccentric strength, and improve general strength.

POWER AND RFD PHASE

This phase has a sport-specific focus and aims to increase overall power production. The structure is consistent with the other phases and incorporates upper/lower, push/pull, and full body to allow for effective and balanced development. The first 2 exercises in each session are strength focused (squat, deadlift, and RDL) and should be completed with maximal RFD in mind. The program then introduces exercises such as medicine ball slams, medicine ball rotational throws, clap push-ups, partner slides, box jumps, and pallof chops to assist power development. Due to the importance and variety of power production needed in SB, each session includes a variety of linear, rotational, and antirotational power exercises. This reflects the need to produce linear and rotational forces during jump take-off, and the need to resist rotational forces (prevent overrotation or correcting body position) during the landing phase of aerials (49). To address this, contrasting exercises such as medicine ball rotational throws and pallof press antirotation exercises have been included.

If substituting medicine ball exercises with Olympic-style lifts, the order of exercises in the session should change. To ensure the lifts are performed safely with adequate technique, these should be completed at the start of the session when the athlete is unlikely to be fatigued (9). As described in Table 2, the prescription during this phase generally consists of low reps, long rest, and fast tempo. These factors play a role in promoting quality repetitions and maximal efforts during each set. It should be noted that novice and intermediate-level athletes may require longer rest periods to enable adequate recovery and ensure technique quality is maintained.

WARM-UP CONSIDERATIONS

It is widely accepted that dynamic warm-ups before exercise is crucial for the execution of peak performance and mitigating risk of injury (16,24,32). Most traditional sports have a comprehensive literature base to guide evidence-based warm-up practices. Few investigations, however, have focused on snow sport populations and the unique considerations that may influence the effectiveness of widely accepted warm-up procedures. SB athletes are often exposed to extremely cold temperatures (−30° to −10 °C) during training and competition. In addition, athletes can often remain inactive and stationary in the cold between runs for up to 15 minutes (14).

A combination of neuromuscular, dynamic reactivation, and passive rewarming protocols was found to be an effective warm-up strategy in cold temperatures (14). Therefore, it is suggested that SB athletes may benefit from subtle deviations from traditional warm-ups, through the implementation of warm-up protocols based off the “raise, activate, mobilize, potentiate” protocol described by Jeffreys (24). This protocol is an effective strategy to ensure the athlete is physically ready for the session, while also providing a platform to develop general athletic skills, which in turn can assist with LTAD. “Raise” can be achieved by incorporating various modes of low-intensity exercise, as detailed in Table 6, aimed at elevating body temperature, respiratory rate, HR, blood flow, and joint viscosity. Exercise selection should prioritize enjoyment, autonomy, and creativity to increase engagement with freestyle athletes. Dynamic stretches and low-intensity exercise can be incorporated to address “activate and mobilize.” Stretch selection should reflect the exercises completed in the session. Dynamic stretches for SB athletes should generally focus on ROM through the ankle, knee, hip joints, and thoracic region (14). The “potentiate” phase aims to

Table 4
Resistance training (session 2)

Strength					Strength + RFD					RFD + power				
	Sets × reps, intensity					Sets × reps, intensity					Sets × reps, intensity			
Exercise	Wk 1	Wk 2	Wk 3	Wk 4	Exercise	Wk 1	Wk 2	Wk 3	Wk 4	Exercise	Wk 1	Wk 2	Wk 3	Wk 4
Front squat	3 × 6 at 70%	3 × 8 at 75%	4 × 8 at 80%	3 × 6 at 75%	Front squat	3 × 4 at 75%	3 × 6 at 80%	4 × 6 at 85%	3 × 6 at 80%	Front squat	3 × 4 at 75%	3 × 5 at 80%	4 × 4 at 85%	3 × 4 at 80%
Single-leg hip thrusts	3 × 4 at 70%	3 × 6 at 75%	4 × 6 at 80%	3 × 6 at 75%	Single-leg hip thrusts	3 × 4 at 75%	3 × 6 at 80%	4 × 6 at 85%	3 × 6 at 80%	RDL	3 × 4 at 75%	3 × 5 at 80%	4 × 4 at 85%	3 × 4 at 80%
Nordics	3 × 4	3 × 6	4 × 6	3 × 6	Walking lunge	3 × 6 at 75%	3 × 8 at 80%	4 × 8 at 85%	3 × 8 at 80%	Partner slides	3 × 20 s	3 × 30 s	3 × 45 s	3 × 30 s
Bent-over row	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Nordics	3 × 4 at 2RIR	3 × 6 at 1RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Box jumps	3 × 4 at 2RIR	3 × 4 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
D'bell chest press	3 × 4 at 2RIR	3 × 6 at 2RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Bent-over row	3 × 4 at 2RIR	3 × 6 at 1RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Pallof chops	3 × 4 at 2RIR	3 × 4 at 1RIR	4 × 4 at 0RIR	3 × 4 at 1RIR
Pallof press	3 × 30 s	3 × 30 s	3 × 45 s	3 × 30 s	D'bell chest press	3 × 4 at 2RIR	3 × 6 at 1RIR	4 × 6 at 1RIR	3 × 6 at 2RIR	Stir the pot	3 × 30 s	3 × 30 s	3 × 45 s	3 × 30 s
Plank	3 × 1 min	3 × 1 min	3 × 1.5 min	3 × 1 min	Swiss ball plank	3 × 1 min	3 × 1 min	3 × 1.5 min	3 × 1 min	Plank	3 × 1 min	3 × 1 min	3 × 1.5 min	3 × 1 min

Intensity: (%) of 1 repetition maximum or (RIR) reps in reserve. Number of predicted additional repetitions before exhaustion.

Tempo: Wk 1: Normal (quick concentric) Wk 2: Isometric overload (pause at end range) Wk 3: Eccentric overload (increase time under tension during eccentric phase) Wk 4: Normal.

Exercises: *Stir the Pot: Athlete assumes plank position with forearms on a Swiss ball and draws imaginary circles with arms *Partner Slides: One athlete pushes partner (half-squat position) across on low friction floor.

Table 5 List of exercise variations	
Exercise (in program)	Variations
Deadlift	Trap bar, sumo, single leg
Squat	Front, back, split, sumo, goblet, barbell, kettlebell, box
Lunge	Front, back, split, sumo, walking, reverse, barbell, dumbbell
Hip thrusts	Glute bridge, banded, barbell, kettlebell, plate
Nordics	Partner, res. band assist, Swiss ball, machine assisted
RDL	Stiff leg, single leg, barbell, dumbbell, banded
Push-up	Wide/narrow hands, incline/decline, resistance band, clap, bench press, dumbbell press, horizontal/ vertical med ball push, barbell, dumbbell
Pull-up	Resistance band assisted, supinated/pronated grip, bench pull, bent-over row, lat pull-down, seated row
Med ball slams	Ground (linear), overhead (linear), wall (rotational), low to high (rotational)
Jumps	Box, countermovement, depth, single leg, broad
Partner slides	Sled push, partner/other object push, resistance band sprints
Plank	Front, side, single leg raised, Swiss ball
Pallof press	Isometric hold, Pallof chop, rotations, forward and side press
Stir the pot	Static (isometric), circular, one arm

These exercises include progressions and regressions of the exercises prescribed in the exemplar program. These variations have been included to provide a comprehensive list of alternatives for athletes at different ability levels. Ensure that the technique is performed safely and that the athlete is comfortable with each exercise before substituting a progression into the training plan.

increase the athlete's readiness to perform and address the development of movement skills with respect to their motor abilities in the LTAD continuum. By incorporating exercises presented in Table 6, the athlete may receive long-term adaptations to lower-limb ligament and tendon tissue quality. The difficulty of these exercises should be individualized to the athlete's physical ability level and progression over the preseason should be encouraged (Tables 5 and 6).

SUMMARY

Modern competitive SB requires athletes to possess a wide range of physical qualities. Coaches must identify these attributes and integrate an effective strength and conditioning plan based on a thorough needs analysis. The sample training plan will help athletes build the robustness required for the intense physical demands of the sport and ensure that they are prepared for competition. Therefore, it is advised that a similar training plan is developed to cultivate the necessary training adaptations. The focus of these plans should be based on

Table 6 RAMP warm-up example exercises	
Component	Activities
RAISE (choose 1)	Parkour, freestyle running, obstacle course, mirror games
ACTIVATE + MOBILIZE (choose 5)	Glute bridge, hip external rotation, isometric trunk, BW squats, dynamic stretches; ankle rolls, bum kicks, high knees, walking lunges, reverse lunge, hip hinge, leg kicks, leg swings, thread the needle, walking warrior, arm swings, shoulder and neck rolls
POTENTIATE (choose 2)	Stiff leg jumps, bounding, hopping, single leg jumps, rotational jumps, sprinting
FLOW (choose 1)	Cognitive games (eg, snatch, tic-tac-toe, do what I say, not what I do), juggling, slacklining, skateboarding, listening to music, unstable balance tasks

physical qualities such as full-body strength, lower-body eccentric strength, RFD, and power production. The sample training plan provided can be used as an evidence-based template to develop the physical qualities required of competitive SB athletes and ultimately optimize their readiness for competition.

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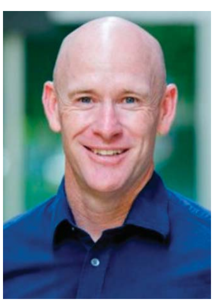

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