

Supplemental Data File 1
Interview guide for athletes

Introduce Study & Build Rapport
Review Consent Form

Main Interview Questions

- Please tell me your date of birth, which sports you have been involved in (how long, what level, position, type of player), histories of injuries, education
- Tell me about your experience with concussions.
 - ⇒ Duration of recovery and severity of symptoms (physical, psychological, social)
- Describe the process of returning to sport/school following your concussion.
 - ⇒ What were your interactions like with people around you (teammates, coaches, family, health professionals)?
 - ⇒ Tell me about some of the things you were thinking/feeling when returning to sport
- Describe how you felt in your first practices/games after returning to play.
 - ⇒ What do you remember most about returning to sport after your concussion?
 - ⇒ How would you know if you were NOT ready to return?
- On a spectrum of not recovered at all to fully recovered, how would you describe how you felt after receiving medical clearance to return to sport?
 - ⇒ What does it mean to be ‘fully recovered’ from a concussion?
- Researchers have found a few factors that are involved in athletes’ psychological readiness to return to sport after an injury:
 - 1) Confidence in returning to sport
 - 2) Realistic expectations of one’s sporting abilities
 - 3) Motivation to regain previous performance standards
 - ⇒ How do those factors map on with your own experiences?
- Has there been anything you have seen in professional sports (including the media) that has influenced the way you think about returning to sport after a concussion?
 - ⇒ Reporting/volunteering symptoms
 - ⇒ Short- and long-term symptoms
- If you were giving a friend, teammate, or family member advice about concussion recovery and return to sport, what would you tell them?
 - ⇒ What, if anything, would you change about your recovery/RTP?

Summary Questions

- Would you like to add any other information to our conversation?
- Do you have any other comments or questions for me?

Supplemental Data File 2
Interview guide for coaches and health professionals

Introduce study & build rapport
Review Consent Form

Main Interview Questions

- Please tell me your date of birth, which sports you have been involved in (how long, what level, history of injuries), education, health professional work experience
- Describe some of your experiences witnessing or interacting with concussed athletes.
 - ⇒ What are some of the challenges that concussed athletes experience? What about during their return to sport after a concussion?
- What do you think it means for an athlete to be ‘fully recovered’ from a concussion?
 - What demonstrates to you that an athlete is NOT ready to return to sport?
- Researchers have found three factors that are involved in athletes’ psychological readiness to return to sport after an injury:
 - 1) Confidence in returning to sport
 - 2) Realistic expectations of one’s sporting abilities
 - 3) Motivation to regain previous performance standards
 - ⇒ How do those factors map on with your own experiences?
 - ⇒ Those three factors were developed through research conducted with athletes who experienced other types of injuries. We do not yet know what it means to be ready—from a psychological standpoint—to return to sport following a concussion. Do you think they can be conceptualized the same way?
- Has anything you have seen in professional sports (including the media) that has influenced the way you think about athletes returning to sport after a concussion?
 - ⇒ Reporting/volunteering symptoms
 - ⇒ Short- and long-term symptoms
- If you were giving a friend, teammate, or family member advice about concussion recovery and return to sport, what would you tell them?
- What are some strategies that you think should be used to help athletes recover and return to sport more effectively?
- What are your thoughts on developing a clinical tool / decision aid to assist with return to play decision making? What might that look like?

Summary Questions

- Would you like to add any other information to our conversation?
- Do you have any other comments or questions for me?

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Supplemental Data File 1: *Interview guide for athletes*

Supplemental Data File 2: *Interview guide for coaches and health professionals*

Table 1.
Graduated Return to Sport Strategy

Step	Aim	Goal
1	Symptom-limited activity	Gradual re-introduction of work/school activities
2	Light aerobic exercise	Increase heart rate
3	Sport-specific exercise	Add movement
4	Non-contact training drills	Exercise, coordination, and <u>increased thinking</u>
5	Full contact practice	<u>Restore confidence</u> and assess functional skills
6	Return to sport	

Note. Adapted from McCrory et al. (2017) Berlin Consensus Statement.

Table 2.
Participant Demographics

Pseudonym	Sport(s) Played/Covered	Sex	Age Range	Highest Education	Sport/Concussions Experiences
Athlete					
A1	Ice hockey	M	20 to 29	Bachelor's degree	<ul style="list-style-type: none"> - Professional ice hockey player - Self-described physical player - 3 known concussions
A2	Ice hockey	F	20 to 29	Bachelor's degree (in progress)	<ul style="list-style-type: none"> - University women's ice hockey player - Self-described the importance of hiding weakness - Has had a couple of concussions
A3	Ice hockey	F	20 to 29	Doctor of Philosophy	<ul style="list-style-type: none"> - University women's ice hockey player - Self-described as a physical player - 4 known concussions (possibly others not identified)
A4	Ice hockey	M	20 to 29	Bachelor's degree	<ul style="list-style-type: none"> - University men's ice hockey player - Self-described as a physical player - 4 known concussions
Coach					
C1	Wrestling	M	30 to 39	Master's degree	<ul style="list-style-type: none"> - Former International level athlete - Uncertain about personal concussion history - Coaching for 9 years
C2	Ice hockey	M	30 to 39	Bachelor's degree	<ul style="list-style-type: none"> - Former professional level athlete - One undiagnosed concussion - Coaching for the past 6 years
C3	Ice hockey	M	30 to 39	Bachelor's degree	<ul style="list-style-type: none"> - Former professional ice hockey player - Had multiple concussions - Has been a coach for 4 years
C4	Ice hockey	F	30 to 39	Bachelor's degree	<ul style="list-style-type: none"> - Former professional ice hockey player - No medically diagnosed concussions, but has experienced symptoms

					<ul style="list-style-type: none"> - Coaching ice hockey at the university level for the past 6 years
C5	Ice hockey	M	30 to 39	Master's degree	<ul style="list-style-type: none"> - Former professional ice hockey player - Experienced 2 diagnosed concussions, others undiagnosed - Coach for 3 years
Athletic Therapist					
AT1	Mostly hockey and football, but also soccer, rugby, basketball, track and field, and swimming	F	30 to 39	Bachelor's degree	<ul style="list-style-type: none"> - Has had multiple concussions - Athletic therapist for 10 years
AT2	Mostly hockey and football, but also soccer, basketball, track and field, and swimming	F	50 to 59	Master's degree	<ul style="list-style-type: none"> - Former university ice hockey and rugby player - One diagnosed concussion - Athletic therapist for 24 years
AT3	Football, basketball, cheerleading, and curling	F	30 to 39	Master's degree	<ul style="list-style-type: none"> - Former volleyball player - Athletic therapist for 6 years
AT4	Soccer, lacrosse, baseball, golf, hockey, volleyball, basketball, cheerleading, figure skating, trampoline, tumbling	F	40 to 49	Master's degree	<ul style="list-style-type: none"> - Played multiple sports as a kid - Experienced a concussion while working as an athletic therapist - Athletic therapist for 21 years
AT5	Ice hockey, football, rugby, and lacrosse	F	20 to 29	Bachelor's degree	<ul style="list-style-type: none"> - Played field hockey and rugby when she was younger - Has had no concussion - Athletic therapist for 2 years
Physiotherapist					
P1	Ice hockey, football, and soccer	F	20 to 29	Master's degree	<ul style="list-style-type: none"> - Former high-level athlete in soccer and ringette - 2 diagnosed concussions - Physiotherapist for 2 years
P2	Mostly ice hockey, rugby, and lacrosse	F	20 to 29	Master's degree	<ul style="list-style-type: none"> - Has practiced figure skating, swimming, and alpine skiing when she was younger - Undiagnosed concussions - Physiotherapist for 6 years
P3	Ice hockey, gymnastics, figure	F	50 to 59	Bachelor's degree	<ul style="list-style-type: none"> - Practice tennis, swimming, and dance

	skating, soccer, fencing				- Physiotherapist for 25 years
P4	Boxing, gymnastics, judo, swimming, artistic swimming, water polo	F	30 to 39	Master's degree	- Former diver and volleyball player in high school - Physiotherapist for 7 years
Sports Medicine Physician					
SMP1	Football, rugby, water polo	M	20 to 29	Doctor of Medicine	- Played a lot of sports growing up (ice hockey, rugby, football, baseball, soccer, tennis) - Multiple diagnosed concussions - Sport medicine doctor for 3 years
SMP2	Football, hockey, rugby, volleyball, basketball, rowing, soccer, cycling, ultimate frisbee, Ironman triathlon	M	30 to 39	Doctor of Medicine	- Played multiple sports such as basketball, volleyball, baseball, football, rowing, soccer, tennis, and golf - Has had no concussion - Sport medicine doctor for 1 year
SMP3	Hockey, football, and basketball	F	40 to 49	Doctor of Medicine	- Former basketball, badminton, and volleyball player - Sport medicine doctor for 13 years
Nurse Practitioner					
NP1	Mostly hockey, soccer, and football	F	50 to 59	Doctor of Philosophy	- Played elite ringette - Nurse practitioner for 16 years

Table 3.
Physical factors involved in RTS following SRC

Physical Factors	
2nd level themes and descriptions	Quote examples
Concussion symptoms (13/22): Physical symptoms stemming from concussive injury	<ul style="list-style-type: none"> • “I was like ‘okay, there's a lot of layers to my return to play’, but my first one was ‘I still wake up with a headache every day. I still can't go to sleep at night because I have a headache’.” (A2, F) • “We're trying to get to a point where, from a medical perspective, this person is symptom free. In an ideal world, an athlete has a concussion, seven to 10 days later they have zero symptoms.” (SMD2, M) • “As a person who is asked ‘is this athlete ready to return to competition? or is this athlete ready to return to training?’, we can only base that on the clinical findings. So, we can say ‘okay, what are your list of symptoms?’.” (P1, F)
Returning to pre-injury fitness (8/22): Athlete’s condition before sustaining the concussion	<ul style="list-style-type: none"> • “For me personally, an athlete is ready when he's demonstrated to me in his daily habits, within his life, when he can walk back in the last week of how they've been doing and what they've been doing. And it's in a normal, fully functioning routine and capacity where they're enduring the struggles and embracing those struggles of the day. Whether it be long classes, workouts, and refueling their body and when that week looks normal.” (C5, M)

**Note.* A: Athlete, C: coach, AT: athletic therapist, P: physiotherapist, SMD: sport medicine doctor, NP: nurse practitioner, F: female, M: male. The numbers in brackets corresponds to the number of participants who acknowledged the theme during their interview.

Table 4.
Behavioral factors involved in RTS following SRC

Behavioral Factors	
2nd level themes and descriptions	Quote examples
Avoiding contact or collision (4/22): Actively avoiding plays that involves physical contact	<ul style="list-style-type: none"> • “If they shied away from getting fully hit or backed away or took a step away from hitting somebody that was coming by. They're avoiding that hit or they're trying to avoid going into contact. So, that I've seen before, or they stopped right before the boards because they don't want to get [another athlete] to the boards.” (AT1, F) • “I was like ‘okay, I've seen that my game is going to change, I'm going to be less scrappy when I go back not going to try and get in people's faces to get them to punch me in the face’. I was like, ‘that's probably going to happen’.” (A2, F)
Malingering (7/22): Exaggerated symptoms of illness to avoid practice or game	<ul style="list-style-type: none"> • “... we tend to think that they are happy they have a concussion. So, they don't do exam at school, and they don't have to play because they play just because dad wants them to play. Now they're like free of everything.” (P2, F) • “They get back when they get back, but I should have been pushing him because he was so laid back about it. He just was like ‘I need another week’. He really felt unmotivated to me to get better to the point where I was even questioning like ‘do you actually have symptoms, or you just don't want to go back?’.” (AT3, F)
Playing more passively (9/22): Playing in a way that involves more hesitation than prior the concussion	<ul style="list-style-type: none"> • “As a coach you want to see that there's no hesitation. ‘How do you know that a guy is ready?’. There's no hesitation. You're not dipping your toe in the water. You're not going out there and bumping a guy. You want to see that. You're going out if you're ready to play. I don't want an easy guy back in. I don't want you to tiptoe around. If you're not ready, don't play. Come back when you're ready to play.” (C3, M) • “I will talk to the coaches, ‘how did so and so look at practice? Did they look hesitant? Any concerns?’.” (AT4, F)

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Table 5.
Psychological factors involved in RTS following SRC

Psychological Factors		
2 nd level themes and descriptions	3 rd level themes	Quote examples
Cognitive appraisals (22/22): Ways in which athletes respond and/or interpret their experiences of feeling ready to return to sport following a concussion	Confidence	<ul style="list-style-type: none"> • “What was missing was definitely the confidence in my own abilities.” (A3, F) • “He was a football player, and he just didn't look like himself out there. I'm not sure how to explain it. I guess... maybe to put it the right way; he just didn't look confident in his abilities.” (AT2, F)
	Contemplating retirement	<ul style="list-style-type: none"> • “My parents always said [to me], ‘Hockey's not gonna last forever’, you know, ‘If you're lucky, you get to play until you're 35-40’. I often think, if you got a family or something like that... ‘Do I want to be this guy that just absolutely loses it on his kids, or something like that? Or on [my] wife? [Or the guy who] can't hold a job because he implodes or doesn't have the same mental capacity that he had when he got his degree?’” (A1, M) • “[Athletes] are going to be teachers or healthcare professionals, or whatever. They don't want to have [long-term] problems, right? So I think they recognize like, ‘Yes, I love hockey. But I'm making a career in business’, or whatever the case might be. So, you know, ‘I'm not, I'm not risking my brain for that’, right?” (AT4, F) • “The thing I've also found out... what's really sad... I'm pretty sure that there's one athlete per year—and these are young guys in a university setting—that we've had to have the talk about retirement. And sometimes they approach me. Other times, I'm the one who brings it up. Anytime it's been me who brings it up, there's a giant sense of relief [with the athlete]. Because they didn't want to make the decision. And even though it's been on their mind, there hasn't been one time where I've brought it up where [the athlete has] been shocked.” (SMD3, F)
	Emotions	<ul style="list-style-type: none"> • “It is honestly just my interpretation... but I think there's way more fear with concussion because no one knows. Like, you get bumped and you don't know if you're going to feel better in a couple days or a couple months. All the unknown is so stressful for an athlete.” (AT5, F) • “... it gets to a point where there is a lot of frustration. And especially when they don't see that they're progressing. When it's been a week of

		severe, intense headaches. Or they can't tolerate the light. And they don't see that it's getting better. That's where I have felt their frustration.” (C4, F)
	Internal pressures	<ul style="list-style-type: none"> • “I think I had one case [where the] kid was suffering anxiety. He had like two or three concussions in the past. And almost every time he got hit this year, he came back to the bench crying—at 15 years old. ‘I have a headache. It's the end of my career. I'm not going to get drafted.’” (P2, F) • “... it really doesn't take long for teenagers to spiral out of control. Most of the kids that we saw tended to be female high performing athletes—straight “A” students. Then, they get a head injury, and everything falls out of control. These kids are exceptionally hard on themselves.” (NP1, F)
	Motivation	<ul style="list-style-type: none"> • “When he came back in the New Year, he was appreciative. I hadn't seen anyone more excited and motivated to play in the New Year. I think that's kind of where being patient as a coach pays off. It allows an athlete a little bit of extra time to get that much better. And then [they will] be really excited to play again when they're fully mentally and physically prepared.” (C5, M) • “Athletes are generally highly motivated individuals and are usually driven to a goal. So, what they bring as a challenge to clinical diagnosis is what that athlete will tell you. And if the athlete has figured out that the second they say ‘I have a headache that won't go away’ then the clinician is going to say ‘We need to wait until your headache goes away for you to be considered ready to return’. Then the athlete may not give full information. Or accurate information.” (P3, F)
Individual factors (10/22): Athletes’ personal characteristics that influence concussion and feeling ready to return to sport experiences	Adjusting expectations	<ul style="list-style-type: none"> • “Just celebrating super small things like, ‘Hey, you went outside and went for a fifteen-minute walk and you didn't have a headache. Like, that's awesome.’ So, I think it's about adjusting expectations. And patience, for sure. Adjusting expectations to try and decrease levels of frustration. And then trying to find ways where you have some control in this sort of uncontrollable injury.” (AT3, F) • “I think the best analogy for it is, like during this time that we're in [COVID-19 pandemic], this new normal. I was like, ‘Okay, I'm slowly getting back to normal. But it's not my normal.’ So, I was like, ‘If I'm not even at a new normal yet,’ which I wasn't back when I had this one opportunity to get

		back in the game, 'I'm definitely not ready'." (A2, F)
	Athletic identity	<ul style="list-style-type: none"> • "... I don't care if you're making 700 bucks a week or 7 million a year, you know? You're competitive and you want it. You have an ego. I always say, just because you're playing in our [semi-professional] league doesn't mean your ego is any smaller than the guys playing in the National Hockey League. Like, we've all got [an ego]. Me and you included, you know. And it's all we want. We all have our pride. And I think that makes guys subconsciously brush certain things out of their mind and say that they're okay [to keep playing]." (C2, M) • "... a concussion, you <i>have</i> to report it almost. So, it's almost like you're kind of giving up on yourself. It feels like it, I guess. I don't know. Some people will say, 'Oh, it takes a lot of strength to admit you have a concussion.' But when you're doing it, it feels like you just being a wimp. And [that you're] kind of taking the cheap way out in a way." (A1, M)
	Attitude	<ul style="list-style-type: none"> • "When I say not acting like themselves... Again, I'm with [the athletes] every day. And some of them I've known for four or five years. Like, I <i>know</i> them. And if they come into the room and they're quiet, and they're just sitting in their stall... and I know that's not them. Like that would be something that I would pull them aside and just ask them, like, 'Hey is everything okay? What's going on?'" (AT4, F)
Mental health (13/22): Mental health issues that influencing recovery and feeling ready to return to sport following a concussion	Anxiety/stress	<ul style="list-style-type: none"> • "Even though they are high level athletes and Olympians, often in this case the big thing with [concussion recovery] is the anxiety." (P4, F) • "... You don't know if you're going to feel better in a couple days or a couple months and so all the unknown is so stressful for an athlete." (AT5, F) • "... You have to try to relax and some people have a cloud above their head. You need to treat their anxiety [so they can] get better." (SMD1, M)
	Depression/sadness	<ul style="list-style-type: none"> • "What comes first, the chicken or the egg? Concussion or depression/anxiety, you know? Was that underlying depression and anxiety always there and then the concussion gave it a voice? Or did something happened—really in the neurophysiology, when that athlete's brain was injured—and then that caused depression/anxiety to be a chronic condition now?" (P1, F) • "... Every kid I did see looked the same. They're all sad. They're all isolated. They're all stressed.

		<p>So, I think trying to normalize it is a big part of the care as well.” (NP1, F)</p> <ul style="list-style-type: none"> • “I always check. I ask all my athletes ‘You've been feeling down depressed or disinterested or any increased anxiety or anything?’.” (SMD2, M)
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Table 6.
Social factors involved in RTS following SRC

Social Factors	
2nd level themes and descriptions	Quote examples
External pressures (21/22): Pressure coming from coaches, family or others to return to sport	<ul style="list-style-type: none"> “ ... I'll ask if there are other external stressors. ‘Is the coach putting any stress on you? Are your teammates putting any stress on you to get back? Or your parents putting any stress on you?’.” (AT1, F) “Four months out and, at that point, everyone kept saying ‘well, just take the Christmas break, and you'll be fine’. Our Christmas break is 10 days long. I'm like ‘dude, if four months haven't done it, how will these magical 10 days gonna work?’.” (A2, F)
Interactions between HCPs/coaches and concussed athletes (8/22): Discussions between HCPs/coaches and concussed athletes on their recovery and feeling ready to return to sport	<ul style="list-style-type: none"> “Well, I don't know what I don't know. So, if I don't have that information, I can't do anything. If the doctor said, ‘you're cleared’ and you're coming to tell me that you're fine... Well, what am I supposed to do?” (C1, M) “[I] just trust that I'm not putting them back out there too fast. And if something happens, then we adjust to that too. There's no guarantee. But I am always around, that's my job. I'm a text away, a phone call away. When they can trust that I have their back, I think they embrace it a little bit better.” (AT3, F)
Interactions between HCPs/coaches and concussed athletes' teammates/roommates (7/22): Discussions between HCPs/coaches with the athletes' teammates/roommates about one's concussion recovery	<ul style="list-style-type: none"> “I mentioned that [concussed athletes'] teammates are a big piece to it. So, maybe [I check] in with an older player to [say] ‘Okay, can you go and speak to her, and ask her how she's doing and help support her? I don't know that she's going to tell me everything, but maybe she'll speak to you’. And that can be kept confidential as well. But at least I know there's someone that is helping her in that space.” (C4, F) “... we now have more people coming and saying, ‘Go take a look at [possibly concussed athlete]. There's something not right with him. You've got to check him out because he's acting strange. He's doing something funny’. Much more, for lack of a better word, ‘tattletaling’ on each other.” (AT2, F) “Some of these proud moments I've had is when a teammate has said to me, ‘check out [possibly concussed athlete] because he's not himself. He came off the ice and I think you should talk to him’. I commend that behavior [because] it's your job as a teammate to take care of your buddies. You're not tattling on them. You're potentially helping them make a very good decision... when they may not be able to make that good decision on their own.” (SMD3, F)
Isolation (4/22): Feelings of being alone or having minimal contact with others	<ul style="list-style-type: none"> “That player isolated himself; didn't come to the rink, didn't come to practice. I think maybe still going to class or wasn't going to class. Then, it became a bigger deal when he didn't show up at the rink... And then you have that kind of downward spiral where ‘I'm socially isolated, I'm not training now, I'm not fit, I can't get back’. And that just spirals.” (P1, F) “There's a huge social impact in terms of losing the [sense of] connectedness with the team. Although we try and keep them involved, sometimes they're unable to tolerate that. For example, in hockey, they can't

	<p>tolerate being in the room, with music and chatter and things like that. Or even being at a game. Sometimes we'll say, 'Hey just come at game time and watch'. But the horn or the music or even trying to track the puck, they may not be able to tolerate it. So, they may become a little bit isolated from their teammates and even their friends." (AT4, F)</p>
<p>Social support (11/22): Support given to the athletes from coaches, HCPs and others</p>	<ul style="list-style-type: none"> • "I think our role in an athlete recovery, whether it's physical or mental health and wellbeing, is to be an advocate for them in returning when they're ready. I think we [coaches] can alleviate pressure by having conversations about how they are doing. [For example] sitting down with them away from the rink. Whether it's in a smaller space on campus that's quiet and you can talk in private... talk about just and how they're doing. Checking in on those things is, I think, the most important piece to any athlete's recovery. And showing them support as a coach. So, I think the coach's role is to be a supportive person and helping the athlete to cope adequately with what they're dealing with." (C5, M) • "Sometimes we're just [going] day by day and not everybody can function in that capacity. Staying on them and reassuring them every day that 'It's okay if you have bad days and good days. We'll work through it and just trust the process'." (AT3, F)

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