Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. **Examples of Sport and Non-Sport Activities That Can Lead to Concussions**

Sport activities	Non-sport activities/falls	Excluded from this analysis
• Football • Soccer • Basketball • Cheerleading • Track and field • Dodgeball • Kickball • Recreational play/recess • Tobogganing/sledding • Snowboarding/skiing • Bicycling ** See eTable2 for list of sports included in the current study*	• Slipping on ice or wet surfaces • Falling from stairs or furniture • Tripping and falling while walking • Bumping into doors, walls or furniture • Walking into low-hanging objects • Colliding accidentally with a person • Dropping an object on their head	• MVC: Car, motorcycle, or ATV accidents • Assaults or physical altercations

Notes. ATV=All-Terrain Vehicles; MVC=Motor Vehicle Crashes. These examples represent potential causes of sports and non-sports concussions. While they illustrate possible scenarios, they may not necessarily reflect the specific causes of concussions in the current study. This list is not exhaustive.
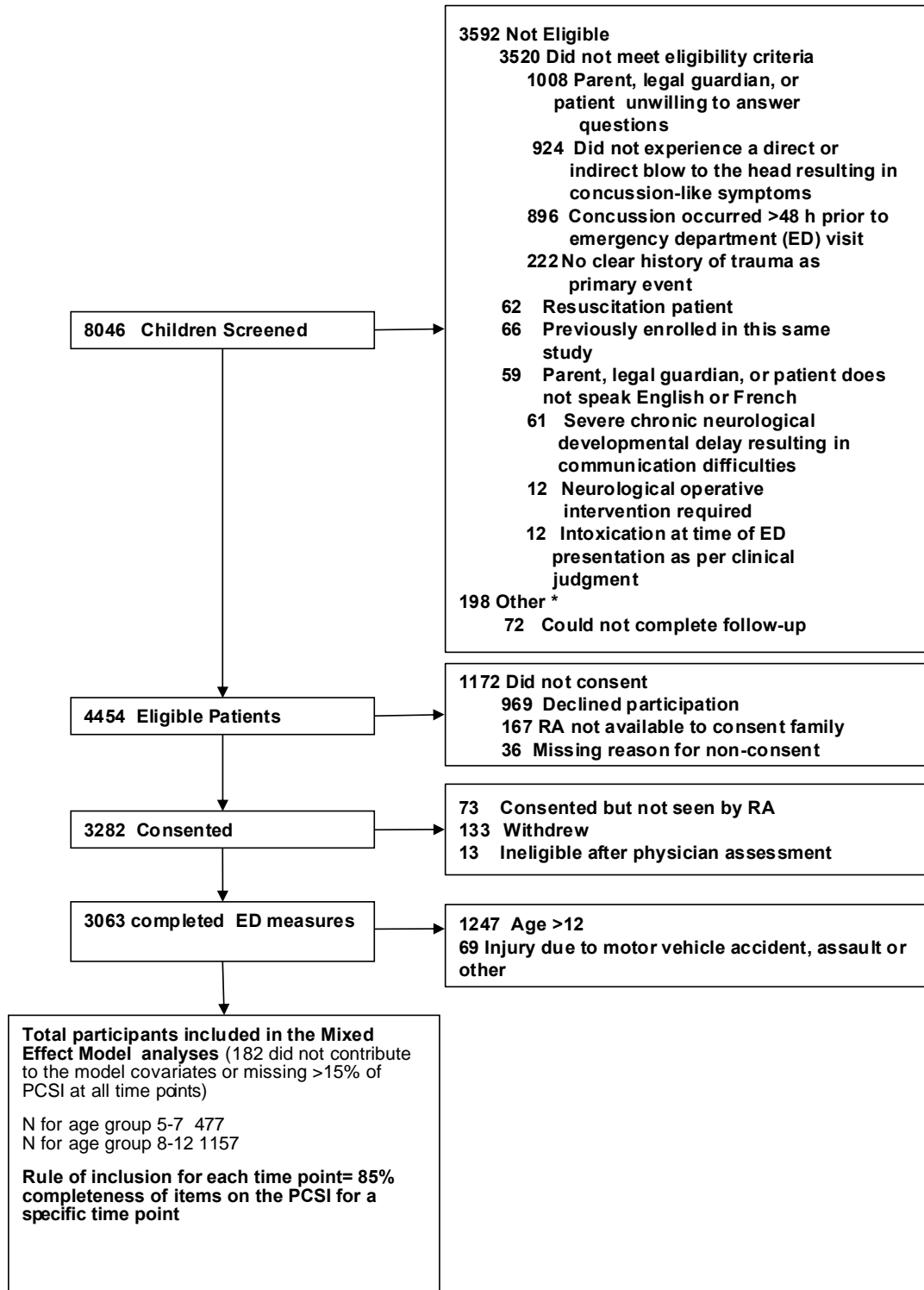
eTable 2. Sport Classification

Contact/Collision	Limited Contact/Impact	Non-contact
• Hockey	• Bicycling	• Recreational play (gym, recess)
• Football	• Horseback riding	• Swimming
• Soccer	• Skateboarding/rollerblading	• Badminton
• Rugby	• Scooter	• Tennis
• Lacrosse	• Basketball	• Flag football/touch
• Ringette	• Volleyball	• Dance
• Roller derby	• Baseball/softball	• Curling
• Combat sports (Karate, Judo, TKD, MMA, Boxing)	• Dodgeball	• Athletics/track
• Wrestling	• Handball	• Earth ball
	• Tchuk ball	• Rock climbing
	• Floor/street hockey	• Hiking
	• Field hockey	• Sailing
	• Trampoline	• Bowling
	• Gymnastics	• Golf
	• Cheerleading	• Strength training
	• Ski/snowboarding	• Cross country skiing
	• Skating	
	• Tobogganing/sledding	
	• Luge	
	• Skeleton	
	• Synchronized swimming	
	• Waterpolo	
	• Watersport (wakeboard)	
	• Parkour	
	• Ultimate Frisbee	

Notes. MMA=Mixed Martial Arts; TKD=Tae Kwon Do.

eTable 3. Missing PCSI Outcome at Each Time Point						
	Age group 5-7				**Age group 8-12**	
Week	**Total**	**Missing PCSI (N)**	**Missing PCSI (%)**	**Total**	**Missing PCSI (N)**	**Missing PCSI (%)**
0	513	19	3.70	1234	30	2.43
1	513	72	14.04	1234	174	14.10
2	513	72	14.04	1234	175	14.18
4	513	85	16.57	1234	183	14.83
8	513	104	20.27	1234	248	20.10
12	513	128	24.95	1234	308	24.96

Notes. PCSI=Post-Concussion Symptom Inventory

eFigure1. Participant Inclusion Flowchart

3592 Not Eligible
    3520 Did not meet eligibility criteria
        1008 Parent, legal guardian, or patient unwilling to answer questions
        924 Did not experience a direct or indirect blow to the head resulting in concussion-like symptoms
        896 Concussion occurred >48 h prior to emergency department (ED) visit
        222 No clear history of trauma as primary event
        62 Resuscitation patient
        66 Previously enrolled in this same study
        59 Parent, legal guardian, or patient does not speak English or French
        61 Severe chronic neurological developmental delay resulting in communication difficulties
        12 Neurological operative intervention required
        12 Intoxication at time of ED presentation as per clinical judgment
    198 Other *
        72 Could not complete follow-up

8046 Children Screened

1172 Did not consent
    969 Declined participation
    167 RA not available to consent family
    36 Missing reason for non-consent

4454 Eligible Patients

73 Consented but not seen by RA
133 Withdrew
13 Ineligible after physician assessment

3282 Consented

1247 Age >12
69 Injury due to motor vehicle accident, assault or other

3063 completed ED measures

Total participants included in the Mixed Effect Model analyses (182 did not contribute to the model covariates or missing >15% of PCSI at all time points)

N for age group 5-7 477
N for age group 8-12 1157

Rule of inclusion for each time point= 85% completeness of items on the PCSI for a specific time point

ED=Emergency Department; RA=Research Assistant; PCSI=Post-Concussion Symptom Inventory.

eTable 4. Personal Characteristics by Type of Contact/Collision

Variable	Age 5-7 years			Age 8-12 years		
	Non-Contact N = 111	Limited Contact N = 44	Collision N = 52	Non-Contact N = 176[1]	Limited Contact N = 229	Collision N = 385
Age	6.67 (0.82)	6.48 (0.88)	6.86 (0.83)	10.32 (1.37)	10.94 (1.48)	10.88 (1.33)
Sex						
Male	71 (64%)	27 (61%)	44 (85%)	105 (60%)	123 (54%)	319 (83%)
Female	40 (36%)	17 (39%)	8 (15%)	71 (40%)	106 (46%)	66 (17%)
Prior concussion and symptom duration						
No prior concussion; symptom duration <1 wk	107 (96%)	43 (98%)	51 (98%)	162 (92%)	216 (94%)	358 (93%)
Prior concussion; symptom duration ≥1 wk	4 (3.6%)	1 (2.3%)	1 (1.9%)	14 (8.0%)	13 (5.7%)	27 (7.0%)
Personal history of migraine	7 (6.3%)	2 (4.5%)	1 (1.9%)	12 (6.8%)	25 (11%)	39 (10%)
History of learning disability	4 (3.6%)	3 (6.8%)	2 (3.8%)	15 (8.5%)	20 (8.7%)	22 (5.7%)
History of attention deficit disorder	6 (5.4%)	6 (14%)	2 (3.8%)	19 (11%)	21 (9.2%)	31 (8.1%)
History of anxiety	1 (0.9%)	4 (9.1%)	2 (3.8%)	16 (9.1%)	16 (7.0%)	17 (4.4%)
History of depression	0 (0%)	0 (0%)	0 (0%)	3 (1.7%)	2 (0.9%)	4 (1.0%)
Loss consciousness	0.18 (0.84)	0.11 (0.43)	0.16 (0.80)	0.08 (0.43)	0.14 (0.77)	0.04 (0.29)
Seizure following injury	2 (1.8%)	1 (2.3%)	2 (3.8%)	2 (1.1%)	4 (1.7%)	8 (2.1%)
ACE - Appears dazed and confused	37 (33%)	24 (55%)	20 (38%)	85 (48%)	112 (49%)	193 (50%)
ACE - Answers questions slowly	37 (33%)	14 (32%)	20 (38%)	74 (42%)	95 (41%)	159 (41%)
ACE - Repeats questions	15 (14%)	2 (4.5%)	7 (13%)	19 (11%)	39 (17%)	34 (8.8%)
ACE - Forgetful of recent information	20 (18%)	5 (11%)	5 (9.6%)	32 (18%)	49 (21%)	59 (15%)
Wore helmet	0 (0%)	12 (27%)	14 (27%)	2 (1.1%)	81 (35%)	237 (62%)
Wore mouthguard	2 (1.8%)	0 (0%)	8 (15%)	2 (1.1%)	3 (1.3%)	140 (36%)
School days missed over past 6 months for any reason	1 (1)	1 (1)	1 (1)	1 (1)	2 (1)	1 (1)
Cognitive score from the Child-SCAT-3	19.4 (5.5)	17.4 (6.6)	19.8 (4.9)	24.8 (3.5)	24.8 (3.4)	25.2 (3.0)
BESS tandem stance # errors	4.1 (3.6)	5.5 (3.6)	5.0 (3.9)	3.5 (3.6)	3.8 (3.7)	3.9 (3.5)

eTable 4. Personal Characteristics by Type of Contact/Collision

Variable	Age 5-7 years			Age 8-12 years		
	Non-Contact N = 111	Limited Contact N = 44	Collision N = 52	Non-Contact N = 176[1]	Limited Contact N = 229	Collision N = 385
Normal neck range	89 (95%)	33 (94%)	41 (93%)	153 (97%)	193 (97%)	330 (97%)
NA	17	9	8	18	31	45
Tenderness of neck	12 (13%)	4 (11%)	4 (9.1%)	27 (17%)	42 (21%)	78 (23%)
NA	17	9	8	18	31	47

Notes. ACE=Acute Concussion Evaluation; BESS= Balance Error Scoring System; Child-SCAT-3= Child-Sport Concussion Assessment Tool-3.

eTable 5. Association Between Symptom Trajectories and Time Stratified by Sport-Related Concussion (SRC) and Non-SRC in Children Aged 5-7 (N=477)

Characteristic	Beta	95% CI[1]	p-value
Type of injury			0.4
Non-sport/Fall	—	—	
Sports/Recreation	1.40	-1.90, 4.70	0.4
Age	0.15	-0.21, 0.51	0.4
Time			**<0.001**
rcs(time, parms = my.knots)time	-2.10	-2.30, -1.90	<0.001
rcs(time, parms = my.knots)time'	6.20	5.60, 6.90	<0.001
Type of collision			0.6
Non-Contact	—	—	
Limited Contact	-0.05	-0.90, 0.81	>0.9
Collision	-0.39	-1.20, 0.40	0.3
Prior concussion and symptom duration			0.2
No prior concussion; symptom duration <1 week	—	—	
Prior concussion; symptom duration ≥1 week	0.75	-0.44, 1.90	0.2
Personal history of migraine	0.25	-0.71, 1.20	0.6
History of learning disability	-1.00	-2.20, 0.15	0.09
History of attention deficit disorder	0.79	-0.28, 1.80	0.15
History of anxiety	-0.43	-1.80, 0.91	0.5
Loss of consciousness duration	0.03	-0.36, 0.42	0.9
Seizure following injury	0.25	-1.30, 1.80	0.8
ACE - Appears dazed and confused	0.68	0.20, 1.20	**0.01**
ACE - Answers questions slowly	0.41	-0.08, 0.91	0.10
ACE - Repeats questions	0.62	-0.10, 1.30	0.09
ACE - Forgetful of recent information	-0.06	-0.66, 0.53	0.8
Wore helmet	-0.39	-1.50, 0.75	0.5
Wore mouthguard	-0.08	-1.70, 1.60	>0.9
School days missed over past 6 months for any reason	0.24	0.03, 0.45	**0.03**
Child-SCAT3	-0.01	-0.05, 0.03	0.7
BESS tandem stance # errors	0.06	0.00, 0.11	**0.04**
Type of injury * Age			0.5
Sports/Recreation * Age	-0.16	-0.65, 0.33	0.5
Type of injury * Time			0.8
Sports/Recreation * rcs(time, parms = my.knots)time	0.01	-0.29, 0.30	>0.9
Sports/Recreation * rcs(time, parms = my.knots)time'	-0.09	-1.10, 0.92	0.9

Notes. ACE=Acute Concussion Evaluation; BESS=Balance Error Scoring System; CI=Confidence Interval; SCAT3= Sport Concussion Assessment Tool version 3. Bold denotes significance.

eTable 6. Association Between Symptom Trajectories and Time Stratified by Sport-Related Concussion (SRC) and Non-SRC in Children Aged 8-12 (N=1,157)

Characteristic	Beta	95% CI[1]	p-value
Type of injury			0.3
Non-sport/Fall	—	—	
Sports/Recreation	-1.60	-4.80, 1.70	0.3
Age	0.23	-0.03, 0.49	0.087
Time			**<0.001**
rcs(time, parms = my.knots)time	-2.6	-2.8, -2.4	<0.001
rcs(time, parms = my.knots)time'	15	14, 16	<0.001
Type of collision			0.5
Non-Contact	—	—	
Limited Contact	0.17	-0.51, 0.86	0.6
Collision	-0.20	-0.88, 0.49	0.6
Prior concussion and symptom duration			0.06
No prior concussion; symptom duration <1 wk	—	—	
Prior concussion; symptom duration ≥1 wk	0.73	-0.03, 1.50	0.06
Personal history of migraine	0.36	-0.27, 1.00	0.3
History of learning disability	-0.50	-1.30, 0.28	0.2
History of attention deficit disorder	-0.17	-0.90, 0.57	0.7
History of anxiety	1.10	0.26, 1.90	**0.01**
History of depression	-1.50	-3.5, 0.54	0.2
Loss of consciousness duration	0.41	0.09, 0.73	**0.01**
Seizure following injury	1.40	-0.14, 2.90	0.08
ACE - Appears dazed and confused	0.68	0.24, 1.10	**0.002**
ACE - Answers questions slowly	0.78	0.33, 1.20	**<0.001**
ACE - Repeats questions	0.79	0.14, 1.40	**0.02**
ACE - Forgetful of recent information	0.76	0.21, 1.30	**0.007**
Wore helmet	0.06	-0.54, 0.67	0.8
Wore mouthguard	-0.30	-1.0, 0.44	0.4
School days missed over past 6 months for any reason	**0.29**	**0.09, 0.48**	**0.004**
Child-SCAT3	**-0.08**	**-0.14, -0.02**	**0.008**
BESS tandem stance # errors	**0.16**	**0.10, 0.21**	**<0.001**
Type of injury * Age			0.4
Sports/Recreation * Age	0.14	-0.17, 0.44	0.4
Type of injury * Time			>0.9
Sports/Recreation * rcs(time, parms = my.knots)time	-0.01	-0.23, 0.21	>0.9
Sports/Recreation * rcs(time, parms = my.knots)time'	0.11	-1.50, 1.70	0.9

Notes. ACE=Acute Concussion Evaluation; BESS=Balance Error Scoring System; CI=Confidence Interval; SCAT3= Sport Concussion Assessment Tool version 3. Bold denotes significance.

eTable 7. Association Between Symptom Trajectories and Time Stratified by Sport Classification for Children Aged 5-7

Characteristic	N$_{obs.}$	Beta	95% CI[1]	p-value
Age	1,090	-0.06	-0.52, 0.39	0.8
Type of collision	1,090			0.6
Non-Contact		—	—	
Limited Contact		-0.50	-1.70, 0.68	0.4
Collision		-0.36	-1.40, 0.73	0.5
Time	1,090			**<0.001**
rcs(time, parms = my.knots)time		-2.0	-2.30, -1.70	<0.001
rcs(time, parms = my.knots)time'		6.50	5.40, 7.50	<0.001
Prior concussion and symptom duration	1,090			0.3
No prior concussion; symptom duration <1 wk		—	—	
Prior concussion; symptom duration ≥1 wk		0.95	-0.99, 2.90	0.3
Personal history of migraine	1,090	0.25	-1.40, 1.90	0.8
History of learning disability	1,090	-1.90	-3.70, -0.09	**0.04**
History of attention deficit disorder	1,090	1.50	0.01, 3.00	**0.05**
History of anxiety	1,090	-0.43	-2.30, 1.50	0.7
Loss of consciousness duration	1,090	0.07	-0.37, 0.51	0.8
Seizure following injury	1,090	0.75	-1.40, 2.90	0.5
ACE - Appears dazed and confused	1,090	0.49	-0.33, 1.30	0.2
ACE - Answers questions slowly	1,090	1.10	0.20, 1.90	**0.02**
ACE - Repeats questions	1,090	1.00	-0.09, 2.20	0.07
ACE - Forgetful of recent information	1,090	-0.63	-1.70, 0.39	0.2
Wore helmet	1,090	-0.58	-1.90, 0.68	0.4
Wore mouthguard	1,090	-0.08	-1.90, 1.80	>0.9
School days missed over past 6 months for any reason	1,090	0.24	-0.12, 0.60	0.2
Child-SCAT3	1,090	0.01	-0.06, 0.08	0.7
BESS tandem stance # errors	1,090	0.04	-0.05, 0.14	0.4
Type of collision * Time	1,090			0.2
Limited Contact * rcs(time, parms = my.knots)time		0.36	-0.17, 0.90	0.2
Collision * rcs(time, parms = my.knots)time		-0.21	-0.71, 0.29	0.4
Limited Contact * rcs(time, parms = my.knots)time'		-1.20	-3.20, 0.87	0.3
Collision * rcs(time, parms = my.knots)time'		1.10	-0.85, 3.00	0.3

Notes. ACE=Acute Concussion Evaluation; BESS=Balance Error Scoring System; CI=Confidence Interval; SCAT3= Sport Concussion Assessment Tool version 3. Bold denotes significance.

eTable 8. Association Between Symptom Trajectories and Time Stratified by Sport Classification for Children Aged 8-12

Characteristic	N_obs.	Beta	95% CI[1]	p-value
Age	4,083	0.32	0.15, 0.50	**<0.001**
Type of collision	4,083			0.5
Non-Contact		—	—	
Limited Contact		0.45	-0.41, 1.30	0.3
Collision		0.16	-0.68, 0.99	0.7
Time	4,083			**<0.001**
rcs(time, parms = my.knots)time		-2.60	-2.90, -2.40	<0.001
rcs(time, parms = my.knots)time'		16	14, 19	<0.001
Prior concussion and symptom duration	4,083			**0.02**
No prior concussion; symptom duration <1 wk		—	—	
Prior concussion; symptom duration ≥1 wk		1.10	0.15, 2.00	0.02
Personal history of migraine	4,083	-0.08	-0.85, 0.70	0.8
History of learning disability	4,083	0.08	-0.88, 1.00	0.9
History of attention deficit disorder	4,083	-0.49	-1.40, 0.38	0.3
History of anxiety	4,083	1.60	0.59, 2.6	**0.002**
History of depression	4,083	-0.19	-2.50, 2.20	0.9
Loss of consciousness duration	4,083	0.41	-0.13, 0.95	0.14
Seizure following injury	4,083	1.70	-0.07, 3.40	0.06
ACE - Appears dazed and confused	4,083	0.74	0.22, 1.30	**0.006**
ACE - Answers questions slowly	4,083	0.68	0.14, 1.20	0.01
ACE - Repeats questions	4,083	0.58	-0.17, 1.30	0.13
ACE - Forgetful of recent information	4,083	0.74	0.07, 1.40	**0.03**
Wore helmet	4,083	0.00	-0.60, 0.59	>0.9
Wore mouthguard	4,083	-0.24	-0.98, 0.50	0.5
School days missed over past 6 months for any reason	4,083	0.27	0.03, 0.51	**0.03**
Child-SCAT3	4,083	-0.04	-0.12, 0.04	0.3
BESS tandem stance # errors	4,083	0.14	0.07, 0.21	**<0.001**
Type of collision * Time	4,083			0.4
Limited Contact * rcs(time, parms = my.knots)time		0.03	-0.33, 0.38	0.9
Collision * rcs(time, parms = my.knots)time		-0.06	-0.39, 0.26	0.7
Limited Contact * rcs(time, parms = my.knots)time'		-0.78	-3.50, 2.00	0.6
Collision * rcs(time, parms = my.knots)time'		-0.02	-2.50, 2.50	>0.9

Notes. ACE=Acute Concussion Evaluation; BESS=Balance Error Scoring System; CI=Confidence Interval; SCAT3= Sport Concussion Assessment Tool version 3. Bold denotes significance.

eTable 9. Association between Persisting Symptoms After Concussion and Sport Classification for Children Aged 5-7

Characteristic	$N_{obs.}$	log(OR)	95% CI	p-value
Type of collision				**0.04**
Non-Contact	1,687	—	—	
Limited Contact	194	0.66	-0.15, 1.5	
Collision	222	-0.74	-1.6, 0.08	
Time	2,103	-0.17	-0.21, -0.13	**<0.001**

Notes. OR=Odds Ratio. CI=Confidence Interval. Bold denotes significance.

eTable 10. Contrasts for the Simple Effect of Sport Classification in the Association Between Persisting Symptoms After Concussion and Sport Classification for Children Aged 5-7

Contrast	Estimate	SE	p-value
(Non-Contact) – Limited Contact	-0.66	0.41	0.25
(Non-Contact) – Contact/Collision	0.74	0.42	0.18
Limited Contact – Contact/Collision	1.40	0.56	**0.03**

Notes. SE=Standard Error. Bold denotes significance after adjusting for multiple comparisons using the Tukey method.

eTable 11. Association Between Persisting Symptoms After Concussion and Sport Classification for Children Aged 8-12

| Characteristic	$N_{obs.}$	log(OR)	95% CI	p-value
Type of collision				**0.05**
Non-Contact	2,379	—	—	
Limited Contact	1,013	0.43	-0.01, 0.86	
Collision	1,670	-0.15	-0.52, 0.22	
Time	5,062	-0.27	-0.30, -0.25	**<0.001**

Notes. OR=Odds Ratio. CI=Confidence Interval. Bold denotes significance.

eTable 12. Contrasts for the Simple Effect of Sport Classification in the Association Between Persisting Symptoms After Concussion and Sport Classification for Children Aged 8-12

Contrast	Estimate	SE	p-value
(Non-Contact) – Limited Contact	-0.43	0.22	0.13
(Non-Contact) – Contact/Collision	0.15	0.19	0.71
Limited Contact – Contact/Collision	0.57	0.24	**0.04**

Notes. SE=Standard Error. Bold denotes significance after adjusting for multiple comparisons using the Tukey method.

eFigure 2. Proportion of Persisting Symptoms After a Concussion (≥3 Symptoms) Over Time With at Least 10 Patients in Each Sport
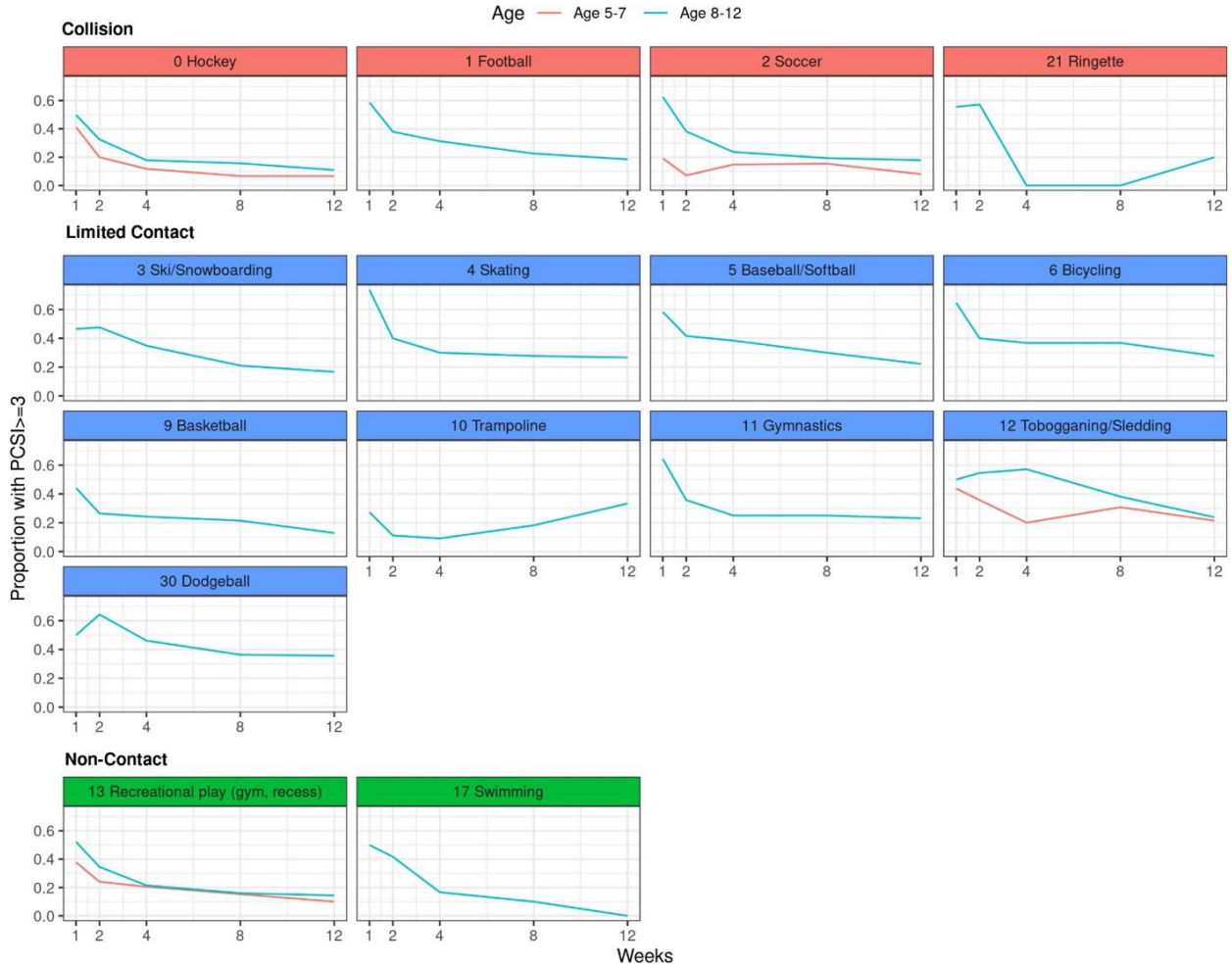
PCSI=Post-Concussion Symptom Inventory. Red indicates the 5-7 age group. Blue indicates the 8-12 age group.