

Appendix Table A4. Characteristics of Included Studies.

Study	Geographic location	Age (years)	Proportion female (%)	Target population	Causes of TBI	Time since TBI	Type of control group (matching)	Severity of TBI	Photophobia testing criteria	Risk of Bias	Study Design
Andersson, et al. (2011) ⁵⁰	Sweden	(26-68)	39	General population	MVA, Fall, Blow	12 months	--	Mild	Post-concussion Symptom Questionnaire: Yes or No	Low	Prospective
Babcock, et al. (2013) ⁵¹	USA	(5-18)	31.2	Pediatric	MVA, Sport, Fall, Cycling, Assault	3 months	--	Mild	Rivermead: graded	Low	Retrospective
Barker-Collo, et al. (2018) ²⁰	New Zealand	25.68±8.4	58	General population	Fall, Assault, Traffic Accident, Recreational	2 weeks 1 month 6 months 12 months	--	Mild	Rivermead: graded	Low	Prospective
Barrett, et al. (1994) ²¹	UK	37 (11.6-88.2)	28	General population	MVA, Industrial, Domestic, Assault, Sports, Others	2 weeks 3 months	--	Mild	Nonstandard symptom tool: Yes or No	Low	Prospective
Benson, et al. (2011) ⁵²	USA and Canada	Median = 27 (18-41)	0	Sports	Sports	<1 day	--	N/R	Nonstandard symptom tool: graded	Low	Prospective
Bergman, et al. (2013) ⁵³	USA	39.27 (18-71)	80	General population	N/R	3 months	Healthy Control (education, age, sex)	Mild	Nonstandard symptom tool: graded	Moderate	Prospective
Bernard, et al. (2017) ⁵⁴	Australia	(2-12)	27	Pediatric	Fall, Collision, Sports	<2 days	Trauma control	Mild	Post-concussion Symptom Scale: graded	Moderate	Prospective
Blinman, et al. (2009) ²²	USA	14.1 (11-19)	30	Pediatric	Fall, MVA, Cycling, Assault, Sports	<4 days 2-3 weeks	--	Mild	ImPACT: graded	Low	Prospective
Bohnen, et al. (1993) ²³	Netherlands	28.3±14.9	50	General population	MVA, Fall, Sport, Fight, Accident at Work	10 days 4-6 weeks 13-15 weeks 22-28 weeks	Healthy control (age, sex)	Mild	Severe or total intolerance to 1500 lux light and post-concussion symptom checklist (graded)	Low	Prospective
Brooks, et al. (2017) ⁵⁵	USA	(7-17)	26	Pediatric	Sports, Fall	0-7 days	--	Mild	Symptom Checklist: graded	Moderate	Prospective
Bryant and Harvey (1999) ⁵⁶	Australia and UK	(16-65)	30.4	General population	MVA	6 months	Trauma control	Mild	Post-concussive Symptom Checklist: Yes or No	Low	Prospective
Candrian, et al. (2018) ²⁴	Switzerland	34.02±12.48	38	General population	Sports, Cycling, Falls, MVA, Other	<1 week 12 months	Healthy Control	Mild	Rivermead: graded	Low	Prospective

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Capó-Aponte, et al. (2017) ²⁵	Germany*	29.33 ± 8.14	9	Military	Blast, Fall, MVA Rollover, Blunt Force, Sports	<45 days <12 months	--	Mild	N/R	Low	Retrospective
Casson, et al. (2010) ⁵⁷	USA	(22-30)	0	Sports	Sports	< 1 day	--	N/R	Nonstandard symptom tool (not stated if graded or not)	Low	Retrospective
Chaput, et al. (2016) ²⁶	Canada	(19-63)	28	General population	MVA, Fall	1 month 8 weeks	--	Mild	Rivermead: graded	Low	Prospective
Chrisman, et al. (2013) ⁵⁸	USA	(13-18)	23	Sports	Sports	≥1 week	--	N/R	Nonstandard symptom tool: graded	Low	Retrospective
Cooksley, et al. (2018) ²⁷	Australia	(18-99)	42	General population	Fall, Road Traffic Accident, Assault, Sports-related, Occupational Incident, Hit on Head	Baseline 3 months	--	Mild	Concussion symptom inventory: graded	Low	Prospective
Cunningham, et al. (2011) ²⁸	Canada	34.1 ± 18.1	50	General population	Fall, Sports, Occupational, Other	2-7 days 1 month	--	Mild	Rivermead: graded	Low	Prospective
Currie, et al. (2017) ⁵⁹	USA	High school age	N/R	Sports	Sports	<1 day	--	N/R	Various tests (e.g., SCAT, ImPACT): graded	Low	Retrospective
Daley, et al. (2016) ⁶⁰	Canada	(12-14)	0	Sports	Sports	2.3±0.7 days	--	N/R	SCAT3: graded	Low	Prospective
De Maio, et al. (2014) ⁶¹	USA	(6-18)	32	Pediatrics	Sports, Fall, Hit by Object, Assault, Other, Motorcycle/ Bike	<1 day	--	N/R	N/R	Moderate	Retrospective
Desai, et al. (2019) ⁶²	USA	(7-18)	39	Sports	Sports	<1 day	--	Mild	ImPACT: graded	Low	Retrospective
Dikmen, et al. (2010) ²⁹	USA	31.3 ± 13.8	24	General population	N/R	1 month 12 months	Trauma control	Moderate-to-Severe, Mild	Symptom Checklist: graded	Low	Prospective
Dillard, et al. (2017) ⁶³	USA	(12-19)	43	Pediatric	Sports, MVA, Bicycle/Motorcycle accident, Blow to the Head, Fall, Other	16 days	--	Mild	ImPACT: graded	Low	Retrospective
Dise-Lewis, et al. (2019) ⁶⁴	USA	14.6 ±1	31	Sports	Sports	1-13 days	--	Mild	ImPACT: graded	Low	Prospective
Elbin, et al. (2016) ⁶⁵	USA	(13-17)	26	Sports	Sports	1 month	--	Mild	ImPACT: graded	Low	Prospective

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Ellis, et al. (2018) ⁶⁶	Canada	(7-19)	36.2	Sports	Sports	8 days	--		Post-concussion Symptom Scale: graded	Low	Retrospective
Emanuelson, et al. (2003) ³⁰	Sweden	(16-60)	37.5	General population	MVA, Fall, Hit by Object	3 weeks 3 months 12 months	--	Mild	CPRS (modified): Yes or No	Low	Prospective
Erlanger, et al. (2003) ⁶⁷	USA	(14-22)	43	Sports	Sports	2 days	--	Mixed	Nonstandard symptom tool: graded	Moderate	Prospective
Eyres, et al. (2005) ⁶⁸	New Zealand	(18-62)	40	General population	N/R	3-6 months	--	N/R	Rivermead: graded	Low	Prospective
Ganti, et al. (2014) ³¹	USA	(18-102)	49	General population	MVA, Fall, Assault, Other	1 week 1 months	--	Mild	Post-concussion Scale: Yes or No	Low	Prospective
Gerber and Schraa (1995) ³²	USA	33 ± 8.6	N/R	General population	MVA, Fall	4 days 6 months	Healthy Control (education, age, sex)	Mild	Nonstandard symptom tool: graded	Low	Prospective
Grubenhoff, et al. (2011) ⁶⁹	USA	(6-18)	32	Pediatric	Blunt Head Trauma	<1 day	Trauma control	Mild	SAC: graded	Low	Prospective
Guskiewicz, et al. (2001) ³³	USA	19.5 ± 1.34	30.6	Sports	Sports	1 day 2 days 3 days 5 days	--	N/R	N/R	Moderate	Prospective
Hall, et al. (2014) ³⁴	USA	(13-93)	27	General population	N/R	<1 month 1-3 months >3 months	--	Mixed	Rivermead: graded	Low	Prospective
Hang, et al. (2015) ³⁵	USA	(11-17)	21	Sports	Sports	<1 day 1 week 2 weeks	--	Mild	ImPACT: graded	Low	Prospective
Heitger, et al. (2007) ³⁶	New Zealand	(15-56)	35.1	General population	Accident, Fall, Hit in head, MVA, Sport	1 week 3 months 6 months 12 months	--	Mild	Rivermead: graded	Low	Prospective
Herrmann, et al. (2009) ⁷⁰	Canada	37.49±17.76	27	General population	N/R	<7 months	--	Mild-to-Moderate	Rivermead: graded	Low	Prospective
Hou, et al. (2012) ³⁷	UK	38.32 ± 14.14	37.3	General population	Accident	3 months 6 months	--	Mild	Rivermead: graded	Low	Prospective
Ingebrigstein, et al. (1998) ⁷¹	Norway and Sweden	30 (10-66)	34	General population	MVA, Fall, Sport, Assault	3 months	--	Mild	Rivermead: graded	Low	Prospective
Kania, et al. (2016) ⁷²	USA	(5-17)	13	Pediatric	Sports, Fall, MVA	1 month	--	Mild	ACE: Yes or No	Low	Retrospective

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Kashluba, et al. (2004) ⁷³	Canada	33.06 ± 12.03	53	General population	Accident, Fall, Hit in head, MVA, Sport	3 months	Healthy control (age, sex, SES, education)	Mild	PCL: graded	Low	Prospective
Kennedy, et al. (2012) ⁷⁴	Afghanistan**	20s	0.9	Military	Blast	<6 hours	--	Mixed	Symptom Scale: Yes or No	Low	Retrospective
King, et al. (1995) ³⁸	UK	Cohort 1: 31 ± 14.3 (16-64) Cohort 2: 34 ±13.2 (17-64)	39.1	General population	Fall, MVA, Sports, Assault	1 week 6 months	--	N/R	Rivermead: graded	Low	Prospective
Kirsch, et al. (2010) ⁷⁵	USA	18>	58	General population	N/R	12 months	--	Mild	Rivermead: graded	Low	Prospective
Kraus, et al. (2014) ³⁹	USA	(18-64)	36	General population	MVA Fall, Assault, Blunt Object	3 months 6 months	--	Mild	Rivermead: graded	Low	Prospective
Lannsjö, et al. (2009) ⁷⁶	Sweden	31 (6-96)	41	General population	Accident, Fall, Hit in head, MVA, Sports	3 months	--	Mild	Rivermead: graded	Low	Prospective
Lee, et al. (2013) ⁷⁷	USA	(13-16) and (18-22)	56.5	Sports	Sports	<1 day	--	N/R	ImPACT: graded	Moderate	Retrospective
Lovell, et al. (2006) ⁷⁸	USA and Canada	16.5 ± 2.0	16.8	Sports	Sports	<5 days	--	N/R	Post-Concussion Scale: graded	Low	Prospective
Lovell, et al. (2013) ⁷⁹	USA	(13-18)	100	Sports	Sports	7 days	--	Mild	ImPACT: graded	Low	Prospective
Lundin, et al. (2006) ⁸⁰	Sweden	37.3 (15-65)	42	General population	MVA, Falls, Alcohol Intoxication	3 months	Healthy control	Mild	Rivermead: graded	Low	Prospective
Marar, et al. (2012) ⁸¹	USA	(14-18)	26	Sports	Sports	<1 day	--	N/R	Nonstandard symptom tool: not stated if graded or not	Low	Retrospective
McLean, et al. (1993) ⁴⁰	USA	(15-60)	38.9	General population	MVA, Fight, Fall	1 month 12 months	Healthy control (age, education, sex, race)	Mixed	Head Injury Symptom Checklist: graded	Low	Prospective
Mittenberg, et al. (1997) ⁸²	USA	(6-15)	N/R	Pediatric	MVA, Fall	6 weeks	--	Moderate-to-Severe, Mild	Nonstandard symptom tool: Yes or No	Moderate	Retrospective
Moss, et al. (1994) ⁸³	England	(18-61)	31	General population	Road traffic Accidents, Assault, Sports, Domestic Circumstances	mean 13 days	--	Mild	Post-Concussion Scale: graded	Low	Prospective
Munivenkatappa, et al. (2013) ⁸⁴	India	(2-76)	7	General population	Fall, MVA	3-6 months	--	Mixed	Rivermead: graded	Low	Prospective

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Nelson, et al. (2017) ⁸⁵	USA	(16-94)	28	General population	MVA, Fall	6 months	--	Mixed	Rivermead: graded	Low	Prospective
Norris, et al. (2014) ⁴¹	Afghanistan**	24 (18-50)	mostly male	Military	Blast	1 week 2 weeks	--	Mild	Nonstandard symptom tool: Yes or No	Low	Retrospective
Paniak, et al. (2002) ⁸⁶	Canada	mTBI: 32.86 ± 11.87 Control: 30.4±11.68	mTBI: 52 Control: 60	General population	Accident, Fall, Hit in head, MVA	1 month	Healthy control (age, sex, SES, education)	Mild	PCL: graded	Low	Prospective
Ponsford, et al. (2011) ⁴²	Australia	34.98 ± 13.13	26	General population	MVA, Fall, Bicycle, Assault, Sports Injury	<2 days 1 week 3 months	--	Mild	PCSI: graded	Low	Prospective
Ponsford, et al. (2019) ⁸⁷	Australia	(18-99)	45	General population	Fall, Violence, Sports related, Road traffic accident, Other	7 months	--	Mild	Rivermead: graded	Low	Prospective
Potter, et al. (2006) ⁸⁸	UK	35.2 ± 14.3	42.3	General population	Work, Fall, Assault, Domestic, Horse-riding	6 months	--	Mild	Rivermead: graded	Low	Retrospective
Roe, et al. (2009) ⁴³	Norway	39	38	General population	MVA, Fall, Violence	3 months 12 months	--	Mild	Rivermead: graded	Low	Prospective
Sady, et al. (2014) ⁸⁹	USA	(5-18)	33	Pediatrics	Sports, Fall, MVA, Other	<13 days	Healthy control	Mild	PCSI: graded	Low	Prospective
Silverberg, et al. (2016) ⁹⁰	USA	(11-22)	30	General population	N/R	<10 days	--	N/R	PCSS: graded	Moderate	Prospective
Starkey, et al. (2018) ⁴⁴	New Zealand	(8-15)	45	General population	Falls, Mechanical Force, Traffic, Assault, Other	Baseline 2 weeks 1 month 6 months 12 months	Healthy Control	Mild	Rivermead: graded	Low	Prospective
Theadom, et al. (2016) ⁴⁵	New Zealand	37.5±17.5	41	General population	Falls, MVA, Exposure to mechanical force, Assault, Other	Baseline 2 weeks 1 month 6 months 12 months	--	Mild	Rivermead: graded	Low	Prospective
Thomas, et al. (2011) ⁹¹	USA	(11-17)	21.7	Pediatric	Sport	3 months	--	Mild	PCSS: graded	Moderate	Prospective
Tschiffely, et al. (2018) ⁹²	USA	(18-46)	1	Military	Blast	<3 days	--	Mild	Military Acute Concussion Evaluation and additional Symptom Checklist: Yes or No	Low	Retrospective
Tyler, et al. (2014) ⁹³	USA and UK	(12-75)	57	General population	N/R	<12 months	--	Mild	Nonstandard symptom tool: graded	Moderate	Prospective

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Villemure, et al. (2011) ⁴⁶	Canada	(14-82)	30	General population	Fall, Assault, Road Accident, Sports, Pedestrian Hit, Impact to the Head	1 week 4 weeks 3 months	--	Mild	Rivermead: graded	Low	Prospective
Waddell and Gronwall (1984) ⁹⁴	New Zealand	(17.53-28.7)	22	General population	N/R	1-2 weeks	--	N/R	Floodlight Severe or total intolerance to 1880 lux light	Moderate	Prospective
Wade, et al. (1997) ⁹⁵	UK	(16-65)	39	General population	MVA, Domestic, Work, Horse-riding, Assault	6 months	--	Mixed	Rivermead: graded	Low	Prospective
Wasserman, et al. (2016) ⁹⁶	USA	College age	27	Sports	Sport	<1 day	--	Mixed	Nonstandard symptom tool: not stated if graded or not	Low	Retrospective
Wojcik (2014) ⁹⁷	USA	25.4 ± 14.3	43.5	General population	MVA, Sport, Blow to Head, Fall	<1 day	--	Mild	Rivermead: graded	Low	Retrospective

USA= United States; UK= United Kingdom
*Evaluation was done by an American at Landstuhl Regional Medical Center, Germany;
** Evaluation was done by an American at a US military-operated concussion clinic in Afghanistan;
N/R= Not Reported; TBI= Traumatic Brain Injury; MVA= Motor Vehicle Accident; mTBI= Mild Traumatic Brain Injury; ACE = Acute Concussion Evaluation; CPRS= Comprehensive Psychopathological Rating Scale; IMPACT= Immediate Post-Concussion Assessment and Cognitive Test; PCL= Post-concussion checklist; PCSI = Post-concussion symptom Inventory; PCSS= Post-concussion Symptom Scale; SAC = Standardized Assessment of Concussion; SCAT3 = Sport Concussion Assessment Tool. Risk of bias is based on 10 criteria formulated and validated by Munn et al.,¹⁶ where a higher score indicates greater bias (Low 0-3; Moderate 4-6; High 7-10).