

## Supplemental Online Content

Beauchamp MH, Tang K, Ledoux A, et al; Pediatric Emergency Research Canada A-CAP Study Team. Optimal recovery following pediatric concussion. *JAMA Netw Open*. 2025;8(3):e251092. doi:10.1001/jamanetworkopen.2025.1092

**eTable 1.** Summary Statistics for the 11 Optimal Functioning Components and Score Criteria

**eTable 2.** Comparison of Baseline Characteristics Between Participants Included and Excluded From Final Statistical Model

**eTable 3.** Postmodel Fit Contrasts Quantifying the Relationship Among Group, Time, and Sex on Optimal Functioning

**eFigure.** Distribution of Wellness Score and Subscores Over Time by Participant Group

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

**eTable 1. Summary statistics for the 11 optimal functioning components and score criteria**

|    |                                        | OI        |     |     |                      | Concussion    |     |                      |               |       |
|----|----------------------------------------|-----------|-----|-----|----------------------|---------------|-----|----------------------|---------------|-------|
| #  | Measure                                | criterion | N   | n   | median (Q1,Q3)       | n (%) optimal | n   | median (Q1,Q3)       | n (%) optimal | P     |
| 1  | Total physical activity hours/week 10D | ≥7        | 813 | 275 | 6.8 (2.0, 15.8)      | 136 (49.5)    | 538 | 4.0 (1.2, 10.5)      | 200 (37.2)    | <.001 |
| 2  | HBI somatic 10D                        | ≤2        | 829 | 278 | 2.0 (0.0, 5.0)       | 161 (57.9)    | 551 | 9.0 (5.0, 14.0)      | 60 (10.9)     | <.001 |
| 3  | BESS tandem stance 10D                 | ≤3        | 773 | 236 | 2.0 (1.0, 3.0)       | 201 (85.2)    | 537 | 2.0 (1.0, 4.0)       | 375 (69.8)    | <.001 |
| 4  | PedsQL physical activity 10D           | ≥87.77    | 828 | 278 | 85.9 (71.9, 93.8)    | 122 (43.9)    | 550 | 81.2 (65.6, 90.6)    | 170 (30.9)    | <.001 |
| 5  | CNS vital signs standard score 10D     | ≥90       | 815 | 274 | 99.0 (87.0, 107.0)   | 193 (70.4)    | 541 | 93.0 (78.0, 105.0)   | 305 (56.4)    | <.001 |
| 6  | HBI cognitive 10D                      | ≤4        | 829 | 278 | 4.0 (1.0, 9.0)       | 149 (53.6)    | 551 | 13.0 (6.0, 20.0)     | 102 (18.5)    | <.001 |
| 7  | PedsQL school functioning 10D          | ≥81.31    | 828 | 278 | 80.0 (65.0, 90.0)    | 104 (37.4)    | 550 | 70.0 (55.0, 80.0)    | 125 (22.7)    | <.001 |
| 8  | PedsQL social functioning 10D          | ≥84.97    | 828 | 278 | 90.0 (80.0, 100.0)   | 193 (69.4)    | 550 | 85.0 (70.0, 95.0)    | 317 (57.6)    | 0.001 |
| 9  | PedsQL emotional functioning 10D       | ≥79.21    | 828 | 278 | 75.0 (60.0, 90.0)    | 138 (49.6)    | 550 | 70.0 (55.0, 85.0)    | 198 (36.0)    | <.001 |
| 10 | CDRS total 10D                         | ≥30       | 829 | 278 | 30.0 (23.2, 34.0)    | 141 (50.7)    | 551 | 25.0 (20.0, 30.0)    | 149 (27.0)    | <.001 |
| 11 | CASS total 10D                         | ≥214      | 820 | 276 | 214.0 (193.0, 241.0) | 138 (50.0)    | 544 | 214.0 (192.0, 242.2) | 274 (50.4)    | 0.92  |
|    |                                        |           |     |     |                      |               |     |                      |               |       |
| 1  | Total physical activity hours/week 3M  | ≥7        | 721 | 248 | 14.6 (6.5, 26.5)     | 185 (74.6)    | 473 | 14.5 (6.5, 27.8)     | 350 (74.0)    | 0.86  |
| 2  | HBI somatic 3M                         | ≤2        | 728 | 248 | 2.0 (0.0, 5.0)       | 143 (57.7)    | 480 | 3.0 (0.0, 7.0)       | 225 (46.9)    | 0.006 |
| 3  | BESS tandem stance 3M                  | ≤3        | 710 | 240 | 1.5 (1.0, 3.0)       | 209 (87.1)    | 470 | 2.0 (1.0, 3.0)       | 381 (81.1)    | 0.04  |
| 4  | PedsQL physical activity 3M            | ≥87.77    | 727 | 248 | 93.8 (84.4, 100.0)   | 165 (66.5)    | 479 | 93.8 (81.2, 100.0)   | 290 (60.5)    | 0.11  |
| 5  | CNS vital signs standard score 3M      | ≥90       | 708 | 243 | 100.0 (89.5, 109.5)  | 182 (74.9)    | 465 | 96.0 (84.0, 107.0)   | 295 (63.4)    | 0.002 |
| 6  | HBI cognitive 3M                       | ≤4        | 728 | 248 | 3.0 (0.0, 11.0)      | 136 (54.8)    | 480 | 5.0 (0.0, 13.0)      | 227 (47.3)    | 0.05  |
| 7  | PedsQL school functioning 3M           | ≥81.31    | 727 | 248 | 85.0 (70.0, 95.0)    | 136 (54.8)    | 479 | 80.0 (65.0, 95.0)    | 218 (45.5)    | 0.02  |
| 8  | PedsQL social functioning 3M           | ≥84.97    | 727 | 248 | 95.0 (80.0, 100.0)   | 184 (74.2)    | 479 | 90.0 (80.0, 100.0)   | 331 (69.1)    | 0.15  |
| 9  | PedsQL emotional functioning 3M        | ≥79.21    | 727 | 248 | 80.0 (65.0, 95.0)    | 135 (54.4)    | 479 | 75.0 (60.0, 90.0)    | 232 (48.4)    | 0.13  |
| 10 | CDRS total 3M                          | ≥30       | 727 | 248 | 29.0 (23.8, 34.0)    | 115 (46.4)    | 479 | 27.0 (21.0, 33.0)    | 190 (39.7)    | 0.08  |
| 11 | CASS total 3M                          | ≥214      | 724 | 248 | 221.0 (194.0, 243.2) | 142 (57.3)    | 476 | 220.0 (188.0, 245.0) | 271 (56.9)    | 0.93  |
|    |                                        |           |     |     |                      |               |     |                      |               |       |
| 1  | Total physical activity hours/week 6M  | ≥7        | 693 | 237 | 14.8 (7.0, 28.0)     | 179 (75.5)    | 456 | 16.4 (7.5, 30.0)     | 351 (77.0)    | 0.67  |
| 2  | HBI somatic 6M                         | ≤2        | 701 | 239 | 2.0 (0.0, 5.0)       | 134 (56.1)    | 462 | 3.0 (0.0, 7.0)       | 227 (49.1)    | 0.08  |
| 3  | BESS tandem stance 6M                  | ≤3        | 688 | 237 | 1.0 (0.0, 3.0)       | 204 (86.1)    | 451 | 1.0 (0.0, 3.0)       | 382 (84.7)    | 0.63  |
| 4  | PedsQL physical activity 6M            | ≥87.77    | 699 | 238 | 93.8 (81.2, 100.0)   | 153 (64.3)    | 461 | 93.8 (87.5, 100.0)   | 320 (69.4)    | 0.17  |
| 5  | CNS vital signs standard score 6M      | ≥90       | 690 | 238 | 101.5 (91.0, 111.0)  | 188 (79.0)    | 452 | 98.0 (86.0, 108.0)   | 313 (69.2)    | 0.006 |
| 6  | HBI cognitive 6M                       | ≤4        | 701 | 239 | 4.0 (0.0, 11.0)      | 121 (50.6)    | 462 | 5.0 (0.0, 13.0)      | 216 (46.8)    | 0.33  |

|    |                                 | OI        |     |     |                      | Concussion    |     |                      |               |       |
|----|---------------------------------|-----------|-----|-----|----------------------|---------------|-----|----------------------|---------------|-------|
| #  | Measure                         | criterion | N   | n   | median (Q1,Q3)       | n (%) optimal | n   | median (Q1,Q3)       | n (%) optimal | P     |
| 7  | PedsQL school functioning 6M    | ≥81.31    | 699 | 238 | 85.0 (70.0, 95.0)    | 131 (55.0)    | 461 | 85.0 (65.0, 95.0)    | 234 (50.8)    | 0.28  |
| 8  | PedsQL social functioning 6M    | ≥84.97    | 699 | 238 | 90.0 (80.0, 100.0)   | 172 (72.3)    | 461 | 95.0 (80.0, 100.0)   | 324 (70.3)    | 0.58  |
| 9  | PedsQL emotional functioning 6M | ≥79.21    | 699 | 238 | 80.0 (65.0, 95.0)    | 125 (52.5)    | 461 | 75.0 (60.0, 95.0)    | 228 (49.5)    | 0.44  |
| 10 | CDRS total 6M                   | ≥30       | 700 | 238 | 30.0 (24.0, 35.0)    | 126 (52.9)    | 462 | 27.0 (22.0, 34.0)    | 186 (40.3)    | 0.001 |
| 11 | CASS total 6M                   | ≥214      | 695 | 238 | 222.0 (192.0, 246.0) | 139 (58.4)    | 457 | 223.0 (193.0, 249.0) | 263 (57.5)    | 0.83  |

P values derived from Pearson chi-square tests comparing % optimal between patient groups

**Abbreviations:** BESS: Balance Error Scoring System; C: Child, CASS: Child and Adolescent Support Scale, CDRS: Connor-Davidson Resilience Scale, CNS Vital Signs: Central Nervous System Vital Signs, HBI: Health and Behavior Inventory, HLBQ: Healthy Lifestyle Behaviours Questionnaire, NA: Not Applicable, PedsQL: Pediatric Quality of Life Inventory

**eTable 2. Comparison of baseline characteristics between participants included and excluded from final statistical model**

| Variable                                                     | N   |     | Included (n=743)  |            | Excluded (n=224) |                   | P    |
|--------------------------------------------------------------|-----|-----|-------------------|------------|------------------|-------------------|------|
|                                                              |     |     | n                 | Value      | n                | Value             |      |
| <b>Group, n (%)</b>                                          | 967 | 743 |                   |            | 224              |                   | 0.06 |
| OI                                                           |     |     |                   | 245 (33.0) |                  | 89 (39.7)         |      |
| Concussion                                                   |     |     |                   | 498 (67.0) |                  | 135 (60.3)        |      |
| <b>Site, n (%)</b>                                           | 967 | 743 |                   |            | 224              |                   | 0.65 |
| Calgary                                                      |     |     |                   | 178 (24.0) |                  | 48 (21.4)         |      |
| Edmonton                                                     |     |     |                   | 146 (19.7) |                  | 38 (17.0)         |      |
| Montreal                                                     |     |     |                   | 77 (10.4)  |                  | 23 (10.3)         |      |
| Ottawa                                                       |     |     |                   | 165 (22.2) |                  | 52 (23.2)         |      |
| Vancouver                                                    |     |     |                   | 177 (23.8) |                  | 63 (28.1)         |      |
| <b>Age years, median (IQR)</b>                               | 967 | 743 | 12.3 (10.5, 14.4) |            | 224              | 12.3 (10.5, 14.1) | 0.69 |
| <b>Sex, n (%)</b>                                            | 967 | 743 |                   |            | 224              |                   | 0.37 |
| Female                                                       |     |     |                   | 317 (42.7) |                  | 88 (39.3)         |      |
| Male                                                         |     |     |                   | 426 (57.3) |                  | 136 (60.7)        |      |
| <b>Race/Ethnicity*, n (%)</b>                                | 834 | 743 |                   |            | 91               |                   | 0.02 |
| Asian                                                        |     |     |                   | 61 (8.2)   |                  | 14 (15.4)         |      |
| Black                                                        |     |     |                   | 25 (3.4)   |                  | 3 (3.3)           |      |
| Hispanic                                                     |     |     |                   | 24 (3.2)   |                  | 1 (1.1)           |      |
| Indigenous                                                   |     |     |                   | 13 (1.7)   |                  | 3 (3.3)           |      |
| White                                                        |     |     |                   | 531 (71.5) |                  | 52 (57.1)         |      |
| Other / Multi-racial                                         |     |     |                   | 89 (12.0)  |                  | 18 (19.8)         |      |
| <b>Parental education, n (%)</b>                             | 824 | 743 |                   |            | 81               |                   | 0.51 |
| High school or less                                          |     |     |                   | 117 (15.7) |                  | 12 (14.8)         |      |
| Trades / 2-year college                                      |     |     |                   | 220 (29.6) |                  | 27 (33.3)         |      |
| Bachelor's degree                                            |     |     |                   | 275 (37.0) |                  | 24 (29.6)         |      |
| Higher than Bachelor's degree                                |     |     |                   | 131 (17.6) |                  | 18 (22.2)         |      |
| <b>Material deprivation index (percentile), median (IQR)</b> | 918 | 743 | 26.0 (11.0, 53.0) |            | 175              | 35.0 (12.0, 59.0) | 0.10 |
| <b>Social deprivation index (percentile), median (IQR)</b>   | 918 | 743 | 41.0 (23.0, 66.0) |            | 175              | 46.0 (22.0, 64.5) | 0.75 |
| <b>Mechanism of injury, n (%)</b>                            | 867 | 743 |                   |            | 124              |                   | 0.36 |
| Bicycle related                                              |     |     |                   | 19 (2.6)   |                  | 2 (1.6)           |      |
| Fall                                                         |     |     |                   | 356 (47.9) |                  | 68 (54.8)         |      |

| Variable                                                    | N   |     | Included (n=743) |                 | Excluded (n=224) |                 | P    |
|-------------------------------------------------------------|-----|-----|------------------|-----------------|------------------|-----------------|------|
|                                                             |     |     | n                | Value           | n                | Value           |      |
| Motor vehicle collision                                     |     |     |                  | 8 (1.1)         |                  | 2 (1.6)         |      |
| Struck object                                               |     |     |                  | 216 (29.1)      |                  | 31 (25.0)       |      |
| Struck person                                               |     |     |                  | 118 (15.9)      |                  | 20 (16.1)       |      |
| Other                                                       |     |     |                  | 26 (3.5)        |                  | 1 (0.8)         |      |
| <b>Previous concussion maximum symptom duration, n (%)</b>  | 947 | 743 |                  |                 | 204              |                 | 0.95 |
| <1 week / no previous concussions                           |     |     |                  | 606 (81.6)      |                  | 166 (81.4)      |      |
| 1+ week(s)                                                  |     |     |                  | 137 (18.4)      |                  | 38 (18.6)       |      |
| <b>Child history of migraine, n (%)</b>                     | 945 | 743 |                  | 47 (6.3)        | 202              | 10 (5.0)        | 0.47 |
| <b>HBI cognitive retrospective pre-injury, median (IQR)</b> | 836 | 743 |                  | 7.0 (1.0, 14.0) | 93               | 8.0 (3.0, 15.0) | 0.31 |
| <b>HBI somatic retrospective pre-injury, median (IQR)</b>   | 836 | 743 |                  | 1.0 (0.0, 4.0)  | 93               | 2.0 (0.0, 5.0)  | 0.03 |

**Notes:** included = contributed at least 1 row of data to final model (i.e. if at least 1 of 3 study time-points had complete data); *P* value from Wilcoxon test (continuous) or Pearson chi-square test (categorical); HBI = Health and Behavior Inventory; \*Race/Ethnicity were reported by the participant's primary caregiver on an in-house socio-demographic questionnaire. The "Other / Multi-racial" category was an original survey option that respondents could self-select.

**eTable 3. Post model fit contrasts quantifying the relationship among group, time, and sex on optimal functioning**

| Contrast                       | Interacting Factors          | OR (95%CI)          |
|--------------------------------|------------------------------|---------------------|
| <b>Group: Concussion vs OI</b> | Sex=Female, Time=PA          | 0.24 (0.16, 0.36)   |
| <b>Group: Concussion vs OI</b> | Sex=Female, Time=3M          | 0.57 (0.35, 0.93)   |
| <b>Group: Concussion vs OI</b> | Sex=Female, Time=6M          | 0.89 (0.55, 1.45)   |
| <b>Group: Concussion vs OI</b> | Sex=Male, Time=PA            | 0.37 (0.26, 0.53)   |
| <b>Group: Concussion vs OI</b> | Sex=Male, Time=3M            | 1.20 (0.78, 1.82)   |
| <b>Group: Concussion vs OI</b> | Sex=Male, Time=6M            | 1.18 (0.76, 1.83)   |
|                                |                              |                     |
| <b>Time: 3M vs 10D</b>         | Sex=Female, Group=OI         | 1.69 (1.02, 2.83)   |
| <b>Time: 6M vs 10D</b>         | Sex=Female, Group=OI         | 2.38 (1.36, 4.16)   |
| <b>Time: 6M vs 3M</b>          | Sex=Female, Group=OI         | 1.40 (0.85, 2.32)   |
| <b>Time: 3M vs 10D</b>         | Sex=Female, Group=Concussion | 3.97 (2.39, 6.60)   |
| <b>Time: 6M vs 10D</b>         | Sex=Female, Group=Concussion | 8.75 (4.98, 15.39)  |
| <b>Time: 6M vs 3M</b>          | Sex=Female, Group=Concussion | 2.20 (1.42, 3.41)   |
| <b>Time: 3M vs 10D</b>         | Sex=Male, Group=OI           | 2.33 (1.42, 3.80)   |
| <b>Time: 6M vs 10D</b>         | Sex=Male, Group=OI           | 3.65 (2.15, 6.22)   |
| <b>Time: 6M vs 3M</b>          | Sex=Male, Group=OI           | 1.57 (1.01, 2.45)   |
| <b>Time: 3M vs 10D</b>         | Sex=Male, Group=Concussion   | 7.47 (4.69, 11.90)  |
| <b>Time: 6M vs 10D</b>         | Sex=Male, Group=Concussion   | 11.58 (6.95, 19.27) |
| <b>Time: 6M vs 3M</b>          | Sex=Male, Group=Concussion   | 1.55 (0.99, 2.43)   |
|                                |                              |                     |
| <b>Sex: Male vs Female</b>     | Group=OI, Time=10D           | 0.86 (0.57, 1.31)   |
| <b>Sex: Male vs Female</b>     | Group=OI, Time=3M            | 1.19 (0.72, 1.97)   |
| <b>Sex: Male vs Female</b>     | Group=OI, Time=6M            | 1.33 (0.79, 2.24)   |
| <b>Sex: Male vs Female</b>     | Group=Concussion, Time=10D   | 1.33 (0.97, 1.82)   |
| <b>Sex: Male vs Female</b>     | Group=Concussion, Time=3M    | 2.49 (1.67, 3.73)   |
| <b>Sex: Male vs Female</b>     | Group=Concussion, Time=6M    | 1.75 (1.14, 2.69)   |

**Note:** OR, adjusted odds ratio; 95%CI, 95% confidence intervals. Effect sizes for all relevant interacting factor combinations from multivariable model fit are presented. The study timepoints were post-acute (PA), 3-months post-injury (3M), and 6-months post-injury (6M). OI= orthopedic injury

**eFigure 1. Distribution of optimal functioning score and subscores over time by participant group**

