TABLE 5. CHAMP 2022 checklist of information to include when reporting computational studies of head acceleration events.

Checklist item	Explanation	Example(s)	Reported on Page No
1. Model Development			
(1a) Model selection	The model and version used in analyses; describe any modifications made to model parameters	PMID: 16284560, "The Wayne State University Head Injury Model (Version 2001) was used because…" PMID: 26192950, "On account of the presence of CSF between the meningeal membranes and the brain, a sliding-only contact definition was originally used for these interfaces. The contact definition was, however, found to be incompatible with any currently available MPP versions of LS-DYNA, and since the computational time on a single computational node for the complete THUMS-KTH model together with the vehicle model was considered too long, a tied interface was used instead."	________
(1b) Model reference	The geometry of the model	PMID: 24735430, "The DHIM was created based on a template high-resolution T1-weighted MRI of a person selected from the group of concussed athletes whose head was positioned neutrally without tilting in the MRI." PMID: 2343473, "The geometry of the model was determined by computer tomography, magnetic resonance imaging, and sliced color photos, which were available through the Visible Human Database."	________
(1c) Brain structures	The structures included in the brain model	PMID: 26762217, "…initial model development combined the label maps to include only four distinct parts: cerebrum (combined white and gray matter), cerebellum, CSF and ventricles."	________
(1d) Model elements	Elements used for meshing the brain (e.g., hexahedral meshes)	PMID: 24065136, "…hexahedral brain meshes were developed with feature-based blocking technique using ANSYS ICEM CFD/HEXA 12.0."	________
(1e) Number and size of elements in model	The number of elements used to define the brain model	PMID: 24735430, "In total, the model contains 101,420 nodes and 115,228 elements with a combined mass of 4.562 kg for the head, and 56,632 nodes and 55,062 elements with a combined mass of 1.579 kg for the brain (1.558 kg without the spinal cord). The average element size for the whole head and the brain is 3.2 $\pm$ 0.94 mm and 3.3 $\pm$ 0.79 mm, respectively."	
(1f) Solver	The method used for time integration (e.g., LS-DYNA or ABAQUS solvers)	PMID: 24529781, "The FE solver used in this study was the explicit LS-DYNA_971_7600 code."	________
(1g) Brain material properties	Assignment of brain and membrane structures material properties (e.g., linear viscoelastic, nonlinear, hyper-viscoelastic) and values (e.g., Young's modulus, density and Poisson's ratio for bone; constants for viscoelastic constitutive laws)	PMID: 24063789, "Visco-elasticity was assumed for brain material model and the skull was modeled by a three layered composite shell representing the inner table, the dipole and the external table of human cranial bone."	________
(1h) Skull-brain interface	Boundary conditions between brain and skull and among internal structures (e.g., tied and/or connected or nodal sharing)	PMID: 17096222, "The interface between the skull and the brain was modeled in three different ways ranging from purely tied (no-slip) to sliding (free-slip)."	________
2. Model Validation			
(2a) Validation reference	Medium from which experimental data were collected (e.g., human subjects, cadavers)	PMID: 32240424, "Head rotation in these experiments was induced by directly striking or stopping a cadaveric head…"	________

TABLE 5. continued

Checklist item	Explanation	Example(s)	Reported on Page No
(2b) Validation method	Methods used for collecting experimental data used to validate the brain's responses (e.g., *in vivo*, cadaveric, using neutral density targets, using marker-based strains)	PMID: 28701050, "In the cadaver impact experiments, local displacements were evaluated throughout the brain using a high-speed biplanar X-ray system to track the relative motion of implanted radio-opaque neutral density targets."	
(2c) Impact direction	Direction of the applied loading conditions for model validation experimental data	PMID: 28394205, "We simulated the scenario that resulted primarily in rotation about the axial plane…"	________
(2d) Impact magnitude	Magnitude of the applied loading conditions for model validation experimental data	PMID: 22992118, "…the impactor mass was 5.59 kg and the impactor velocity was 9.94 m/s."	________
(2e) Impact duration	Duration of the applied loading conditions for model validation experimental data	PMID: 34863650, "A typical impact of 100 ms…"	________
(2f) Validation analyses	Methods used for comparing model data to experimental data	PMID: 30608998, "CORrelation and Analysis (CORA) and Normalized Integral Square Error (NISE) are employed to evaluate model validation performance for both brain strain and brain-skull relative motion."	________
3. Model Simulation			
(3a) Model dimensions	Scaling of the model dimensions to match subject or why a representative set of dimensions is appropriate	PMID: 32240424, "For each cadaveric impact, the WHIM was scaled along the three anatomical directions to match with the reported head dimensions"	________
(3b) Simulation data	Description of the simulation data	PMID: 33126836, "The samples included 110 head impacts measured in a variety of contact sports at Stanford University (ref) and their two batches of augmented data sets ($n = 1320$, $110 \times 6 \times 2$), 53 head impacts reconstructed from the NFL (ref) and their four batches of augmented data sets ($n = 1272$, $53 \times 6 \times 4$), and 314 impacts recorded in American high-school football (ref)." PMID: 18278592, "Detailed descriptions of the game film selection and analysis can be found in Pellman *et al*. (2003a, 2003b), while the details regarding the accident reconstruction methodology can be found in Newman *et al*. (1999, 2000, 2005)."	________
(3c) Simulation efficiency	Methods used to enhance simulation efficiency	PMID: 31758002, "In this study, we developed a deep convolutional neural network (CNN) to train and instantly estimate impact-induced regional brain strains with sufficient accuracy."	
(3d) Simulation runtime and hardware platform	Wall clock runtime and computing hardware platform	PMID: 24735430, "All impact simulations were executed on a Linux computer (Intel Xeon E5-2698 with 256 GB memory). A typical impact of 100 ms required ~ 6 h for simulation with Abaqus/Explicit (double precision)."	
(3e) Strain sensitivity to impact kinematics	Methods used to determine how impact kinematics affect simulation outcomes	PMID: 24610384, "Because the focus of our study is to examine the sensitivity of strain-related responses to alin and arot, the θ and α angles characterizing the translational and rotational axes were clustered. A linear regression for each regional output variable (three variables in four ROIs) was performed based on the 100 impact simulation results from each head FE model. An additional linear regression was performed using $v$rot as the single independent variable, and their performances were compared in terms of coefficients of determination (R2). Finally, Pearson correlation was performed between the two FE models to assess the similarity in their responses relative to head impacts."	________

TABLE 5. continued

Checklist item	Explanation	Example(s)	Reported on Page No
4. Data Reporting			
(4a) Outcome measures	Metrics used to evaluate model simulation data (e.g., 95th percentile maximum principal strain), including their calculation (e.g., strain rate)	PMID: 24077860, "The five brain mechanical variables used for comparisons were the maximum principal strain (ε), maximum principal strain rate ($\dot{\varepsilon}$), their product ($\varepsilon \times \dot{\varepsilon}$), von Mises stress ($\delta$), and pressure ($P$)." https://doi.org/10.1016/j.brain.2021.100024, "the axonal strain rate is the logarithmic strain rate component resolved in the direction of fiber alignment"	

TABLE 6. Potential sources of bias resulting from research partnership.

(1) funding for sensor validation/testing,
(2) funding for sensor implementation,
(3) in-kind equipment for study use,
(4) aid in study design and development,
(5) proprietary software for data cleaning and analysis,
(6) help in data analysis, interpretation and dissemination

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SUPPLEMENTARY INFORMATION

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