



CIHR Research Chair: Gender, Work and Health

IRSC Chaire de Recherche: Le genre, le travail et la santé

Return to work after work-related traumatic brain injury

Angela Colantonio, PhD, OT Reg. (Ont.), FCAHS, FACRM

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ABIResearchLab



www.abiresearch.utoronto.ca

Presenters disclosure

- AC and TM have no financial or non-financial interests to disclose
- Speaker Bureau/Honoraria: none
- Consulting fees: none
- Other: none



Objectives

- 1) To understand the incidence and nature of occupational brain injury with a sex and gender lens
- 2) To understand perceived factors associated with return to work after occupational brain injury
- 3) To understand the nature and relevance of sleep disorders associated with occupational brain injury

Overview of TBI

Traumatic brain injury (TBI) is...

- An “alteration in brain function, or other evidence of brain pathology, caused by an external force”
- Major cause of death and disability globally
- Major causes: Falls, motor vehicle crashes, struck by object
- Can happen to anyone!

TBI is more common than we think

- Over 30% with TBI by age 25 (McKinlay et al., 2008)
- 20 % of Ontario High School Students (Ilie et al., 2014)
- Common in vulnerable populations
 - Homeless: 53% (Hwang et al., 2008)
 - Incarcerated: up to 87% (Shiroma et al., 2010)
- Highest incidence in children/youth and older adults (Colantonio et al., 2010)

Healthcare burden of TBI in Canada

- Places substantial burden on the health care system
- By 2031 TBI will be the most prevalent neurological condition
- Indirect economic costs due to working-age disability will increase and will be greatest for hospitalized traumatic brain injury (rising from \$7.3 billion in 2011 to \$8.2 billion in 2031)

PHAC, 2014

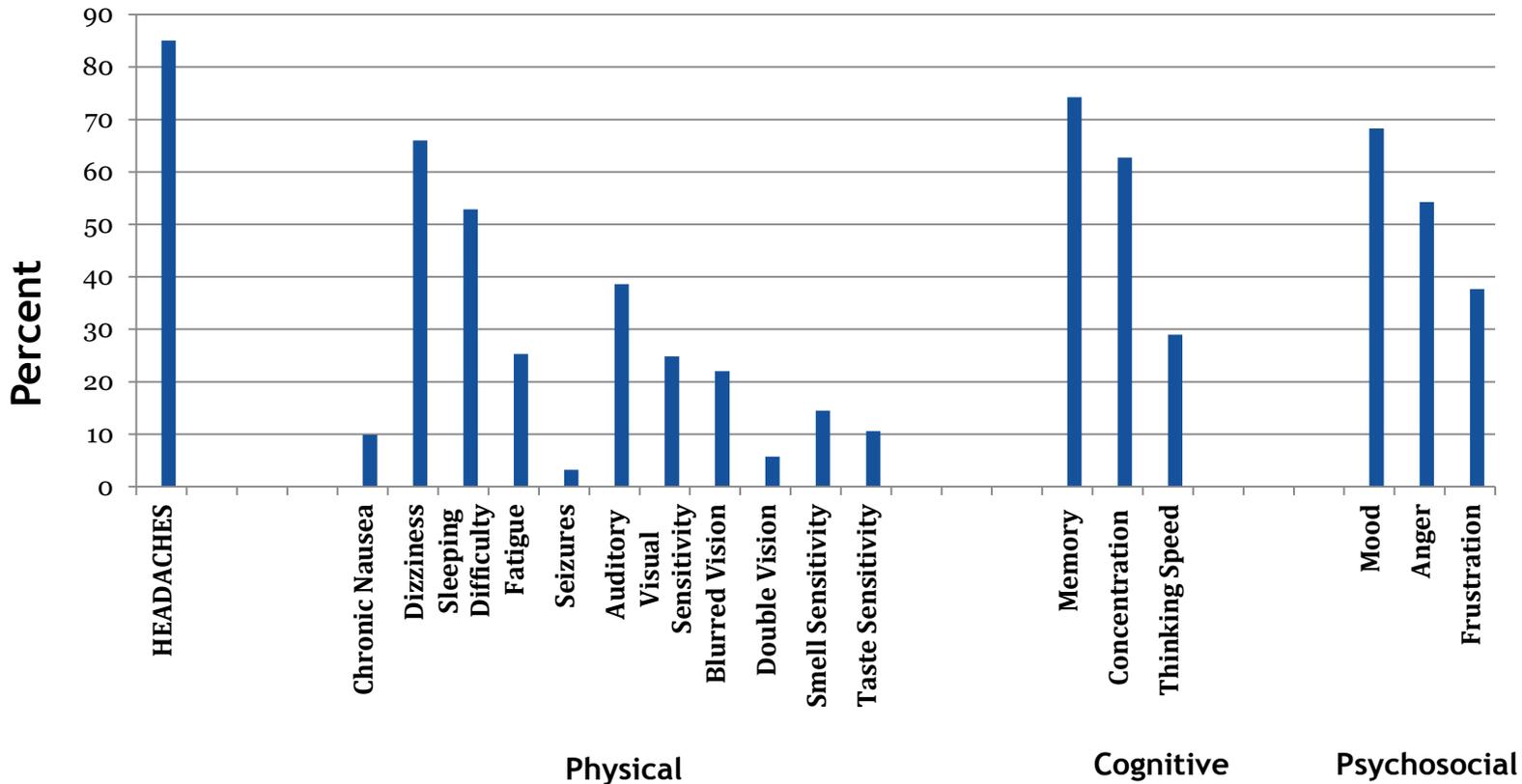
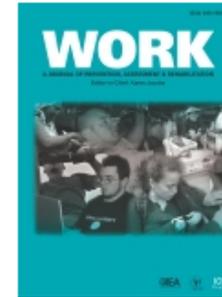
Post-injury symptoms after work related traumatic brain injury in Canadian population

A. Colantonio^{a,b,c,*} and P. Comper^a

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^bDepartment of Occupational Science and Occupational Therapy, Faculty of Medicine, University of Toronto, Toronto, ON, Canada

^cDalla Lana School of Public Health, Division of Epidemiology, University of Toronto, Toronto, ON, Canada



Distribution of post-injury symptoms

Mild injury can have longer term consequences:

Dr. Anne Forrest, PhD in Economics, sustained a mild TBI after rear-end collision

- Did not lose consciousness
 - Struggled with life/work, communication, memory, daily activities
-
- Most people with mild brain injuries recover

TBI at Work (wrTBI)

- Large percentage among seriously or fatally injured workers
- An injury with any loss of consciousness is considered “critical”
- Tremendous need to increase employment opportunities, workplace accommodations, technologies, and policies!
- Employment can make enormous difference in lives of people with a brain injury and their families

TBI Awareness

- Invisible disability
- Stigma
- Can be lifelong: considered a chronic condition
- Need for long term support for individuals/families
- Can be a risk factor for other conditions, for example Alzheimer's Disease, epilepsy

Focus of CIHR Research Chair in Gender, Work and Health:

1. Epidemiology of work-related TBI: Cross-jurisdictional comparisons and implications for prevention
2. Return to work after work-related (wr)TBI
3. Impact of sleep disorders on vocational outcomes of men and women with wrTBI
4. Knowledge translation using research-informed dramatic productions, apps, online fact sheets
5. Capacity building

What is 'sex' and 'gender'?

Sex

Typically refers to “...the biological and physiological characteristics that distinguish males from females”

Gender

Typically refers to the “...socially constructed roles, relationships, behaviours, relative power, and other traits that societies ascribe to women and men”

- Although sex (male/female) and gender (men/women) are both commonly discussed as discrete and binary concepts, CIHR acknowledges that both are fluid and dynamic
- Sex and gender are interrelated; the relationships are complex

(CIHR, 2010)

Epidemiology of work-related(wr)TBI

**AMERICAN JOURNAL OF
INDUSTRIAL MEDICINE**
INCORPORATING ENVIRONMENTAL AND OCCUPATIONAL HEALTH

[Explore this journal >](#)

Review Article

Epidemiology of work-related traumatic brain injury: A systematic review

Vicky C. Chang MPH, E. Niki Guerriero Bsc (Hon), Angela Colantonio PhD 

First published: 2 March 2015 [Full publication history](#)

DOI: [10.1002/ajim.22418](https://doi.org/10.1002/ajim.22418) [View/save citation](#)

- Searched electronic databases (e.g. Medline, Embase)
- 98 studies from worldwide literature were included, 23 specifically focused on wrTBI
- Estimates of burden (incidence, proportion of occupational injuries or TBI), demographics, injury characteristics, outcomes

The numbers on wrTBI...

- Based on worldwide estimates, approximately 2-24% of all TBI incidents are **work-related**
- In Ontario, 7.3% of TBI-related cases identified from the Ontario Trauma Registry are **work-related** (Kim et al., 2006)
- In the US, the proportion of TBIs that are **work-related** ranged from 4-14%

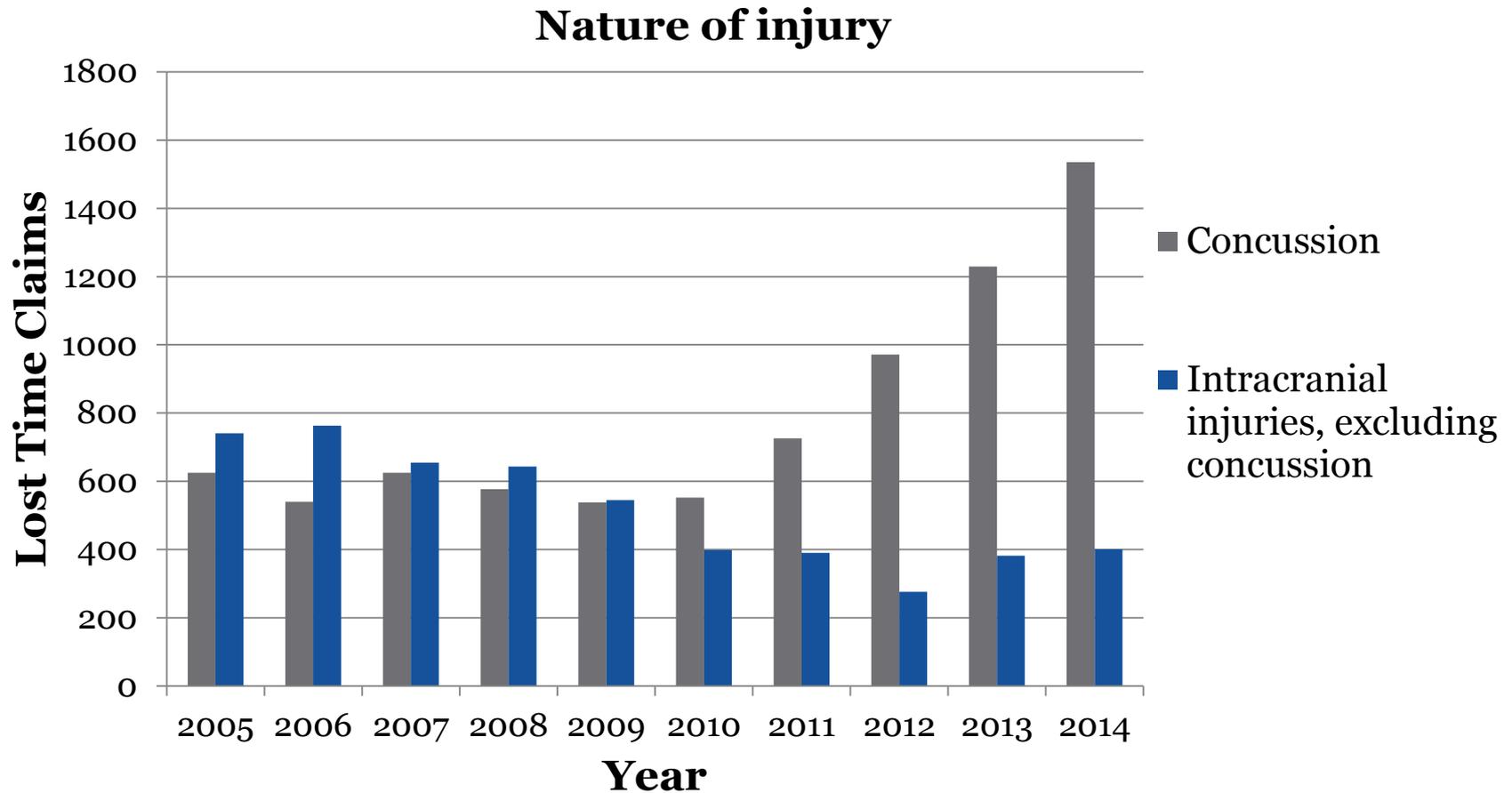


The numbers *cont'd*

TBI accounts for a large proportion of severe and/or fatal work-related injuries:

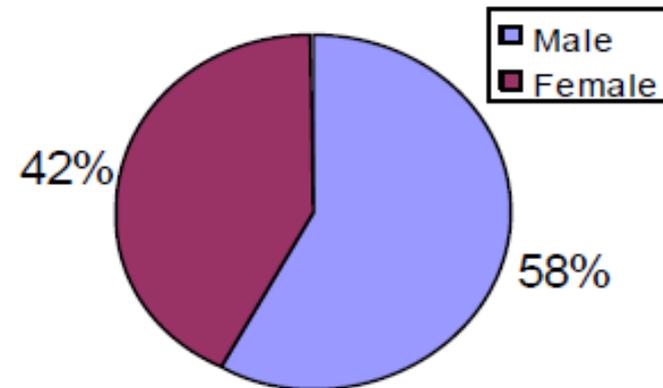
- TBI contributed to approximately **half** of all workplace fatalities in Ontario, based on a review of coroners' records (Tricco et al., 2006)
- **20%** of traumatic occupational injuries and **60%** of work-related deaths in Washington State involved TBI (Sears et al., 2013)

Brain injury in the workplace in Ontario: Lost-time claims

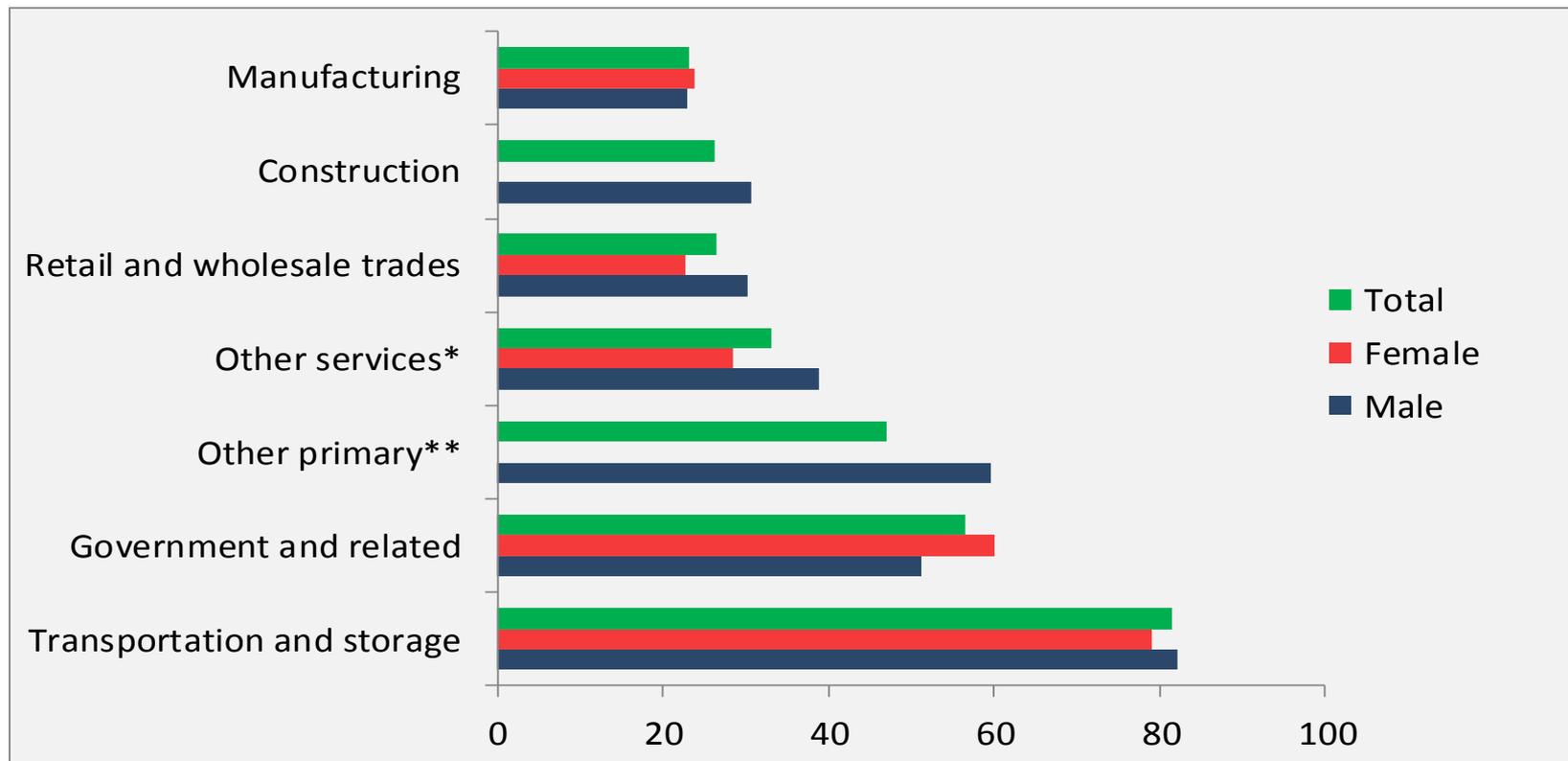


- Males account for the vast majority (>85%) of severe/fatal wrTBI cases
- Percent male decreases when milder injuries are included

- In Ontario, more than 40% of wrTBIs were sustained by females
(Colantonio et al., 2010)



Rates of work related TBI by industry sector (N = 1,047)



Other primary for female group - † (small cell size) Colantonio et al., 2010)

*Includes finance and insurance, business services, accommodation, food and beverage industries.

**Includes mining, forestry, fishing and trapping, agricultural and related industries.

Sex differences in work-related traumatic brain injury due to assault

Tatyana Mollayeva^{a,b,c,*}, Shirin Mollayeva^{d,e}, John Lewko^f and Angela Colantonio^{e,g}

^a*Rehabilitation Sciences Institute, Faculty of Medicine, University of Toronto, Canada*

^b*Collaborative Program in Neuroscience, University of Toronto, ON, Canada*

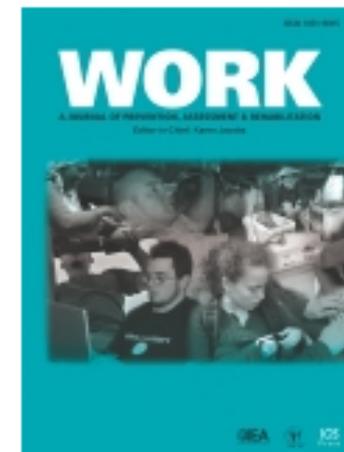
^c*Toronto Rehab-University Health Network, ON, Canada*

^d*Department of Biology, University of Toronto Mississauga, ON, Canada*

^e*Acquired Brain Injury Research Lab, University of Toronto, ON, Canada*

^f*Centre for Research in Human Development, Humanities and Social Sciences, Laurentian University, Sudbury, ON, Canada*

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ORIGINAL ARTICLE

Examining the epidemiology of work-related traumatic brain injury through a sex/gender lens: analysis of workers' compensation claims in Victoria, Australia

Vicky C Chang,¹ Rasa Ruseckaite,^{2,3} Alex Collie,^{2,3} Angela Colantonio^{1,4,5}



Characteristic	Male	Female
Age at injury (median)	37	40
Pre-injury income		
Employer size	Small and medium-sized companies	Large companies, government
Occupation	Machinery operators, drivers, technicians, laborers	Professionals, community and personal service workers
Industry	Manufacturing, construction, transportation/warehousing	Education, healthcare
Mechanism of injury	Fall from an elevation, motor vehicle crashes	Fall from the same level, struck by/against
Claim Costs		
Duration of work incapacity (mean)	68 days	41 days

Conclusions



- Need for approaches to prevention tailored to sex/gender considerations, industry, occupation
- Education is needed about the nature of re-injury after TBI and workplace context for return to work





Return to work after work-related TBI



Return to work after work-related traumatic brain injury

Angela Colantonio^{a,b,*}, Sara Salehi^c, Vicki Kristman^{d,e}, J. David Cassidy^f, Angela Carter^b, Oshin Vartanian^g, Mark Bayley^b, Bonnie Kirsh^a, Debbie Hébert^{a,b}, John Lewko^h, Olena Kubrakⁱ, Steve Mantis^j and Lee Vernich^k

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^k*Research Service Unit, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada*

Objectives

- Employment loss can negatively impact self-identify, autonomy, and emotional well-being
- Return to work (RTW): important goal in rehabilitation process
- Study's objectives:
 - Compare patient profile of injured workers following TBI who have RTW to those who hadn't
 - Identify RTW facilitators and barriers including demographic, clinical, psychosocial, environmental, and occupational factors

Methods

- Retrospective cohort study
- Participants recruited from TRI's Neurology Services in 2010 who underwent a comprehensive assessment after referred by Ontario WSIB
- Telephone interview, with mail-in option in 2011

Perceived facilitators of RTW (n=25)

1. support from family/friends - 92%
2. support from treatment providers - 80%
3. job modifications/employer accommodation – 76%
4. medication use – 72%
5. partial recovery from injury – 72%
6. support from co-workers – 68%
7. workplace commitment to health and safety – 64%
8. early contact from employer – 48%
9. access to RTW planners/coordination – 44%
10. supervisor trained in RTW planning – 44 %

Perceived barriers of RTW (n=51)

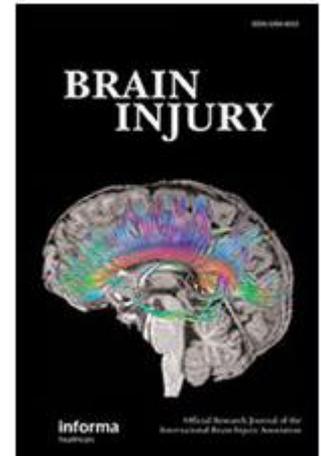
Factors most frequently selected to have hindered RTW by the participants:

1. difficulty thinking and concentrating - 92%
2. fatigue/reduced tolerance and endurance – 96%
3. pain - 88%
4. headaches – 86%
5. sleep disturbance – 82%
6. dizziness or balance problems – 80%
7. emotional/psychological issues – 76%

Return-to-work challenges following a work-related mild TBI: The injured worker perspective

Elizabeth Mansfield, Mary Stergiou-Kita, John David Cassidy, Mark Bayley, Steve Mantis, Vicki Kristman, Bonnie Kirsh, Manuel Gomez, Mark G. Jeschke, Oshin Vartanian, Joel Moody & Angela Colantonio

To cite this article: Elizabeth Mansfield, Mary Stergiou-Kita, John David Cassidy, Mark Bayley, Steve Mantis, Vicki Kristman, Bonnie Kirsh, Manuel Gomez, Mark G. Jeschke, Oshin Vartanian, Joel Moody & Angela Colantonio (2015) Return-to-work challenges following a work-related mild TBI: The injured worker perspective, *Brain Injury*, 29:11, 1362-1369, DOI: [10.3109/02699052.2015.1053524](https://doi.org/10.3109/02699052.2015.1053524)



When a TBI is work-related, RTW is characterized by several distinct features

1. Workers typically return to the pre-injury workplace following a wrMTBI
2. Tensions in the workplace may escalate if employers face increased costs following an occupational injury
3. The legitimacy of an injury claim might be questioned
4. Injured workers could return to workplaces where unsafe hazards and practices have not been addressed
5. When a MTBI takes place in the workplace, the injury is a public event and eliminates the individual's choice whether to disclose a brain injury, a stigmatizing condition that can have negative effects on one's career

Recommendations

- Increasing knowledge of employers, co-workers and workers' compensation representatives related to physical, cognitive and psychosocial impairments resulting from MTBI so injured workers can receive appropriate supports, and mitigate discrimination, stigmatization and re-injury.
- Structural and social elements of workplace and compensation environments should inform strategies to break down barriers to successful return to work following a wrMTBI.
- Greater OHS focus on preventing re-injury following a wrMTBI



Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(2 Suppl 1):S40-5



ORIGINAL RESEARCH

Gender Influences on Return to Work After Mild Traumatic Brain Injury



Mary Stergiou-Kita, PhD, OT,^{a,b,c} Elizabeth Mansfield, PhD,^b Sandra Sokoloff, MLIS,^a
Angela Colantonio, PhD, OT^{a,b}

From the ^aDepartment of Occupational Science and Occupational Therapy, University of Toronto, Toronto, ON; ^bToronto Rehabilitation Institute, University Health Network, Toronto, ON; and ^cInstitute of Work and Health, Toronto, ON, Canada.



Key Findings

6 men and 6 women with mild TBI

- “Breadwinner”, occupational roles important for both men and women
- Women were more proactive in seeking and requesting medical assistance
- More positive return to work experiences in “feminine” versus “masculine” work environments
- Employer and co worker relations were critical elements in return to work

Knowledge Translation

Heads Up: What you need to know about concussions in the workplace

Canadian Centre for Occupational Health and Safety

The screenshot shows the website interface for the Canadian Centre for Occupational Health and Safety (CCOHS). At the top, there are navigation links for 'Government of Canada', 'Government du Canada', 'Canada.ca', 'Services', 'Departments', and 'Français'. The CCOHS logo and a red maple leaf are prominently displayed. A search bar and navigation menu are also visible. The main content area features the 'Health and Safety Report' header, with 'Volume 13, Issue 5' noted on the right. A list of links for related content is provided, including 'Heads-Up: What You Need to Know About Concussions in the Workplace'. Below this is a featured article preview with an image of a person's head and a broken wooden mannequin. The article text discusses the prevalence of concussions in the workplace and provides a link to the full report. On the right side, there are buttons for 'SHARE', 'SUBSCRIBE', and 'UNSUBSCRIBE', along with a 'CCOHS Calendar' section listing upcoming events like 'MRSA - A Stubborn Strain' and 'Saskatchewan Safety Council Annual Industrial Safety Seminar'.

<http://www.ccohs.ca/newsletters/hsreport/issues/2015/05/ezine.html#hsreport-ontopic>

Work-related brain injury app

Designed by the “Traumatic brain injury in the workplace: Innovations for prevention” research team

- Serves as an educational resource on TBI in the workplace for employees and employers
- Currently in development; to be available through iTunes and Google Play Stores in summer/fall 2016



Guidelines for Concussion/mTBI & Persistent Symptoms: Second Edition

© 2013, Ontario Neurotrauma Foundation

<http://onf.org/documents/guidelines-for-concussion-mtbi-persistent-symptoms-second-edition>



Future aim is to include a gendered approach

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SUPPLEMENT 1

Supplement to

Archives of Physical Medicine and Rehabilitation

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Sex, Gender, and Traumatic Brain Injury

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Archives of Physical Medicine and Rehabilitation

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ORIGINAL RESEARCH

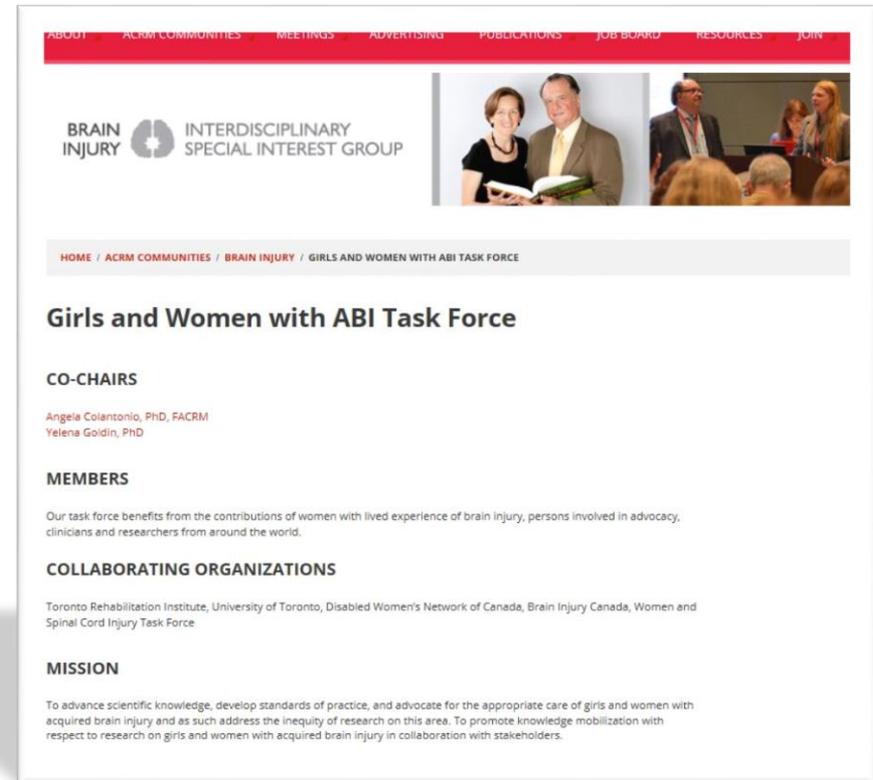
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Task Force on Girls and Women with ABI

The *Task Force on Girls and Women with ABI* evolved from 2010 meeting in Montreal, and is generously supported by the American Congress of Rehabilitation Medicine

Co-Chairs:

Angela Colantonio, PhD,
FACRM & Yelena Goldin, PhD



The screenshot shows a website page with a red navigation bar at the top containing links for ABOUT, ACRM COMMUNITIES, MEETINGS, ADVERTISING, PUBLICATIONS, JOB BOARD, RESOURCES, and JOIN. Below the navigation bar is a header section with the text "BRAIN INJURY INTERDISCIPLINARY SPECIAL INTEREST GROUP" and a circular logo. To the right of the text is a photograph of three people. Below the header is a breadcrumb trail: HOME / ACRM COMMUNITIES / BRAIN INJURY / GIRLS AND WOMEN WITH ABI TASK FORCE. The main content area has the title "Girls and Women with ABI Task Force" and sections for "CO-CHAIRS" (listing Angela Colantonio, PhD, FACRM and Yelena Goldin, PhD), "MEMBERS" (with a description of the task force's benefits), "COLLABORATING ORGANIZATIONS" (listing Toronto Rehabilitation Institute, University of Toronto, Disabled Women's Network of Canada, Brain Injury Canada, Women and Spinal Cord Injury Task Force), and "MISSION" (with a description of the task force's goals).

Sex and Gender Analysis Resources

CIHR Institute of Gender and Health

Sex and gender in biomedical research

<http://www.cihr-irsc-igh-isfh.ca/?lang=en>

NIH Office of Research on Women's Health

*The science of sex and gender in
human health*

<https://sexandgendercourse.od.nih.gov/>

**SCIENCE FACT OR SCIENCE FICTION:
TRAUMATIC BRAIN INJURY: DOES GENDER MATTER?**

<http://www.cihr-irsc.gc.ca/e/49000.html>

www.abiresearch.utoronto.ca
angela.colantonio@utoronto.ca

Thank you



Additional Supporters:



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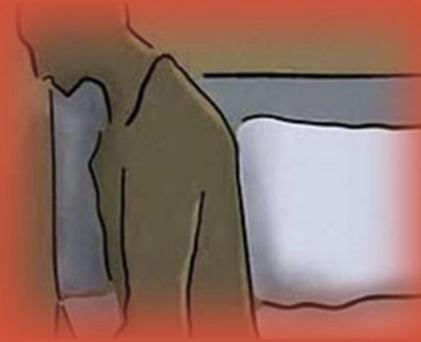


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Canadian Centre for Occupational Health and Safety
Centre canadien d'hygiène et de sécurité au travail





TRAUMATIC BRAIN INJURY, SLEEP DISORDERS AND RETURN TO WORK- RELATED OUTCOMES: PART 2



Tatyana Mollayeva, MD, PhD
Postdoctoral research fellow
Rehabilitation Sciences Institute
Toronto Rehab-University Health Network

Why to study sleep in traumatic brain injury (TBI)?



What is a **traumatic brain injury**?

CNN - Sep 23, 2016

On Thursday, Scott's mother told CNN affiliate WCSC about a "near-death" ... A **traumatic brain injury** usually results from a blow to the head, such as a direct ... drowsiness, having trouble **sleeping** or **sleeping** more than usual, ...



Sleep disturbances after **traumatic brain injury**

Clinical Advisor - Jun 19, 2017

Traumatic brain injuries (TBIs) have become a hot topic since the 2015 film Concussion. An internet search brings up a bevy of articles about ...



Traumatic Brain Injury Can Cause Long-term **Sleep** Problems and ...

Newsweek - Apr 27, 2016

Traumatic Brain Injury Can Cause Long-term **Sleep** Problems and Excessive Daytime Sleepiness. By Jessica Firger On 4/27/16 at 5:57 PM.

Traumatic brain injuries linked with lasting **sleep** problems

CBS News - Apr 27, 2016



Sleep Disorders Among Troops Are More Damaging Than We Realize

Task & Purpose - Apr 25, 2016

More so than even the amputations and **traumatic brain injuries** that to stay awake and maintain **alertness** during daytime sleep periods, and ...



Long after **brain trauma**, sleep problems persist

Los Angeles Times - Apr 27, 2016

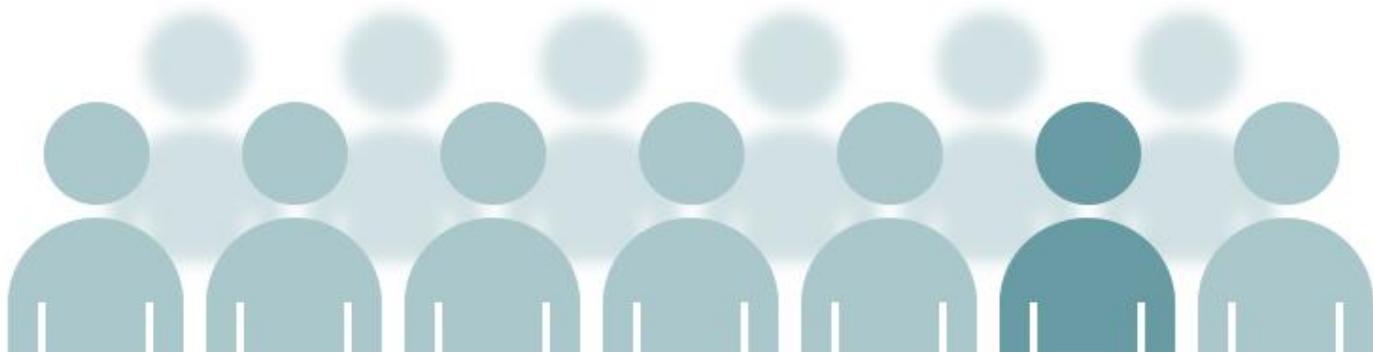
At least 18 months after sustaining a **traumatic brain injury**, first-time concussion victims continue to need more sleep and to suffer more daytime ...

Sleep Problems Persist in Patients With **Traumatic Brain Injury**

Neurology Advisor - Apr 28, 2016

Natural history and significance of sleep dysfunction in mild (m)TBI

- mTBI: **disturbed sleep** is common; a population-based longitudinal study (n=346): <10 % had sleep difficulties pre-injury, 65% had at 2 wks, and 41 % at 1 year post-injury¹
- Strong association btw **disturbed sleep** in mTBI and **psychiatric disorders**, physical and cognitive impairments, overall functioning^{2,3}



¹Theadom A, Cropley M, Parmar P, Barker-Collo S, Starkey N, Jones K, et al. Sleep difficulties one year following mild traumatic brain injury in a population-based study. *SleepMed*. 2015;16:926–32.

²Scherer M, Belben T, Colantonio A, Thurairajah P, Mollayeva T. The relationship between sleep, depression, and traumatic brain injury: a study of Ontario workers with head trauma. *Journal of Sleep Disorders: Treatment and Care* 2015; 4:1.

³Mollayeva T, Mollayeva S, Colantonio A. The Risk of Sleep Disorder Among Persons with Mild Traumatic Brain Injury. *Curr Neurol Neurosci Rep*. 2016;16(6):55

Relevance of sleep research in work-related (wr) mTBI

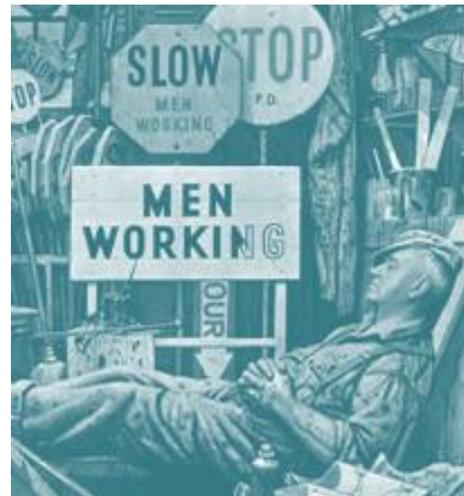
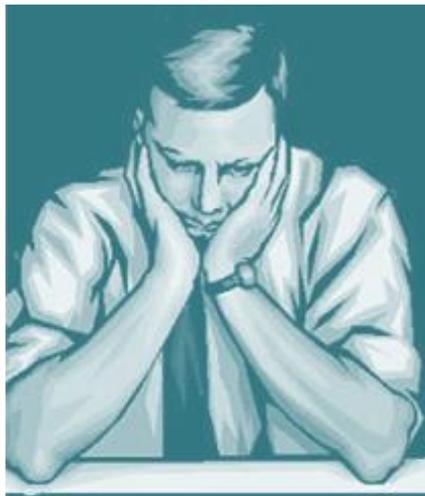
- Practical context #1: **safety concern**, i.e., particularly where there is a limited time to decide and act (i.e., high risk occupations: mining, transportation, policing, etc.)
- Practical context #2: **functional capacity**, i.e., inability to function at desired level
- Practical context #3: **regulatory** perspective on return-to-work after the injury
- **Scientific knowledge gaps**: individual differences in insufficient sleep-related performance impairment; effect of inadequate sleep, behaviour, role of disturbed circadian pacemaker on recovery post injury



The gap: sleep after wr mTBI



- Sleep function in **wr mTBI** and its relationship to clinical and non-clinical outcomes
- The project: ***Disorders of sleep and wakefulness in Ontario workers with wr mTBI***

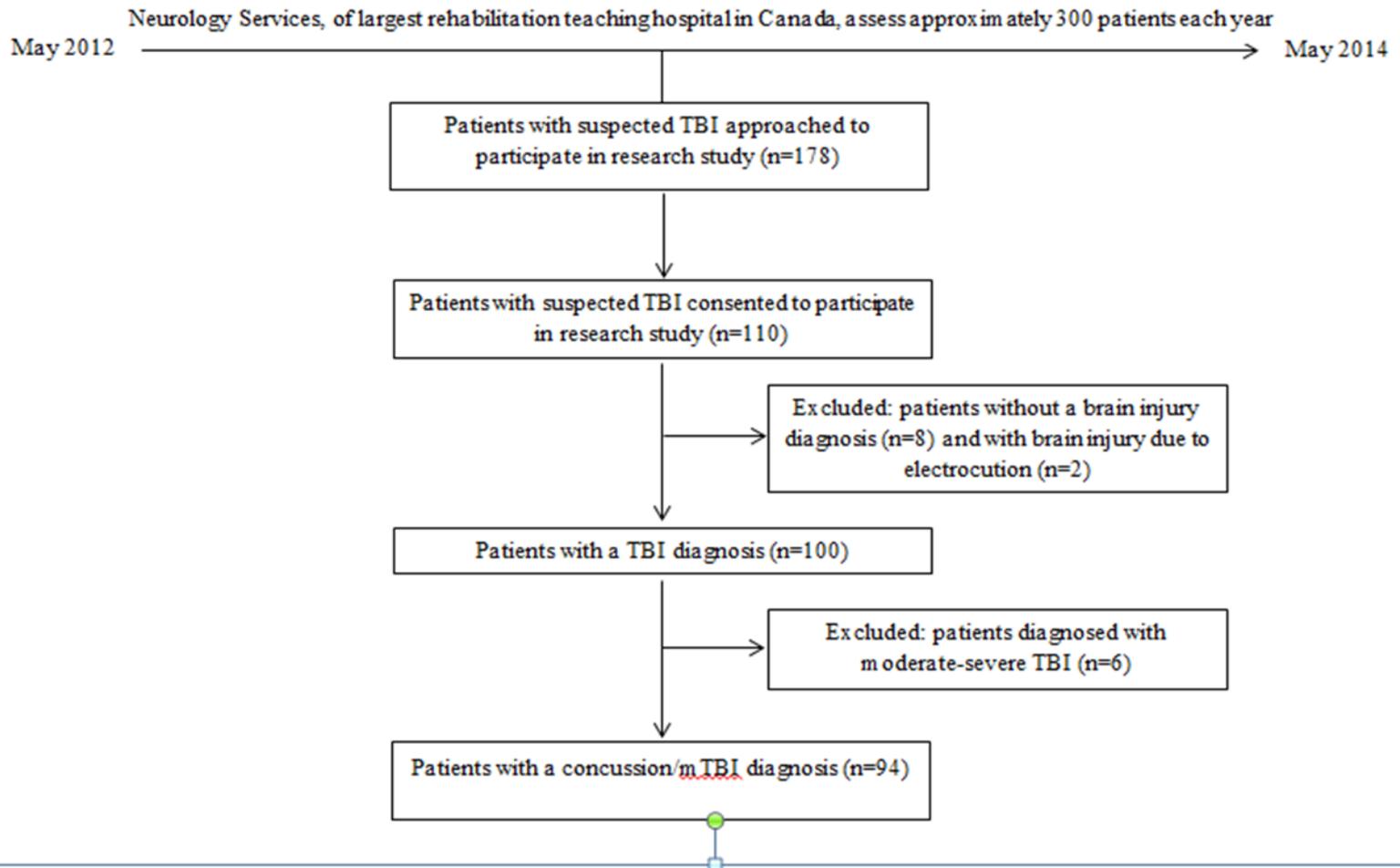


Research program goals



- Describe the study population: workers with delayed recovery from mTBI, and their **sleep**
- Investigate associations between sleep and relevant clinical and functional outcomes:
 - Chronic pain
 - Fatigue, alertness, and sleepiness
 - Community integration, and perceived disability
- Highlight factors associated with insomnia, and those that drive deviations in sleep structure in persons with wr mTBI

Study participants (injured workers)



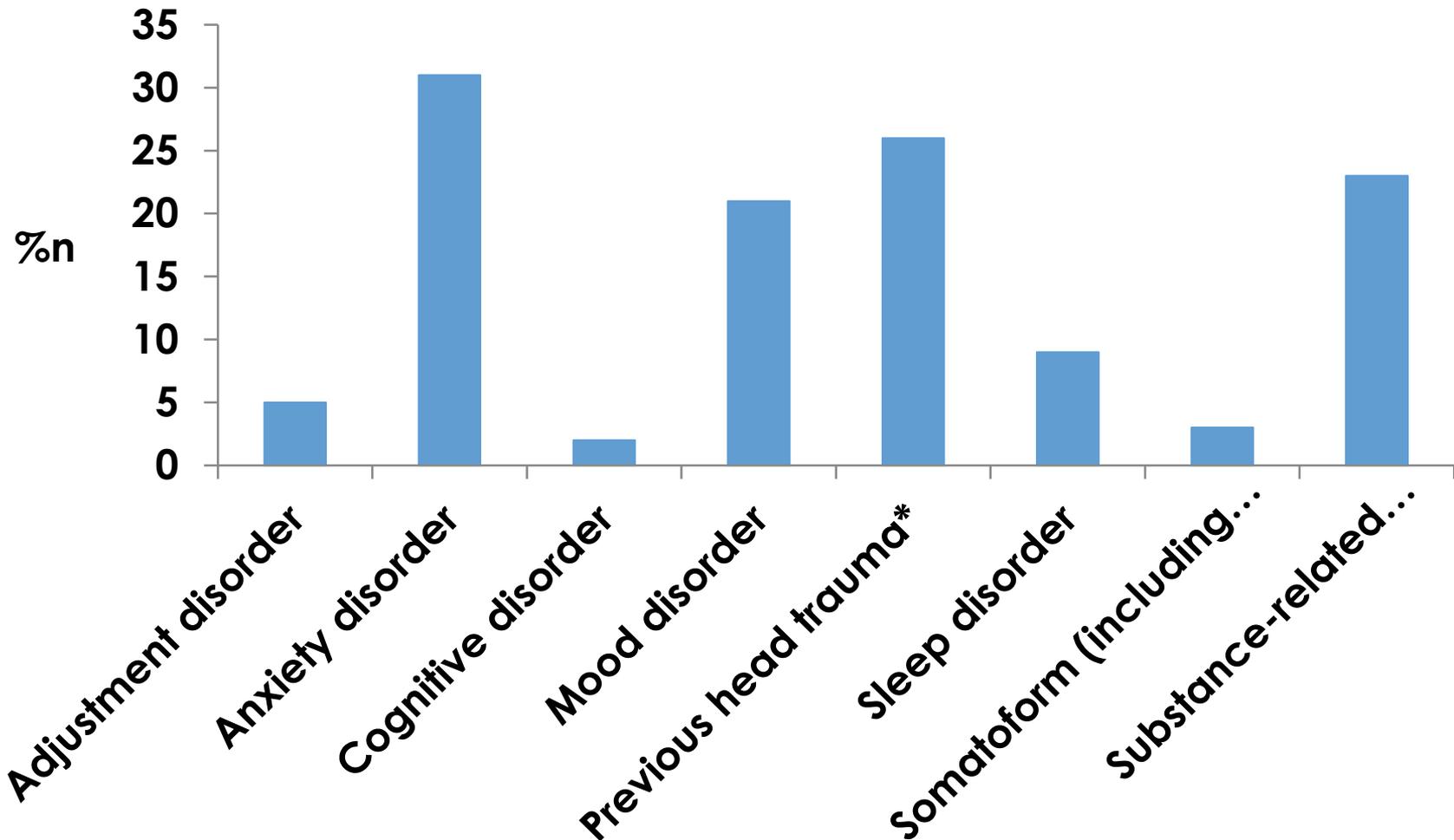
Supplementary figure 1. Flow chart depicting process of selection of participating individuals' data for analysis. Traumatic brain injury; TBI

Results

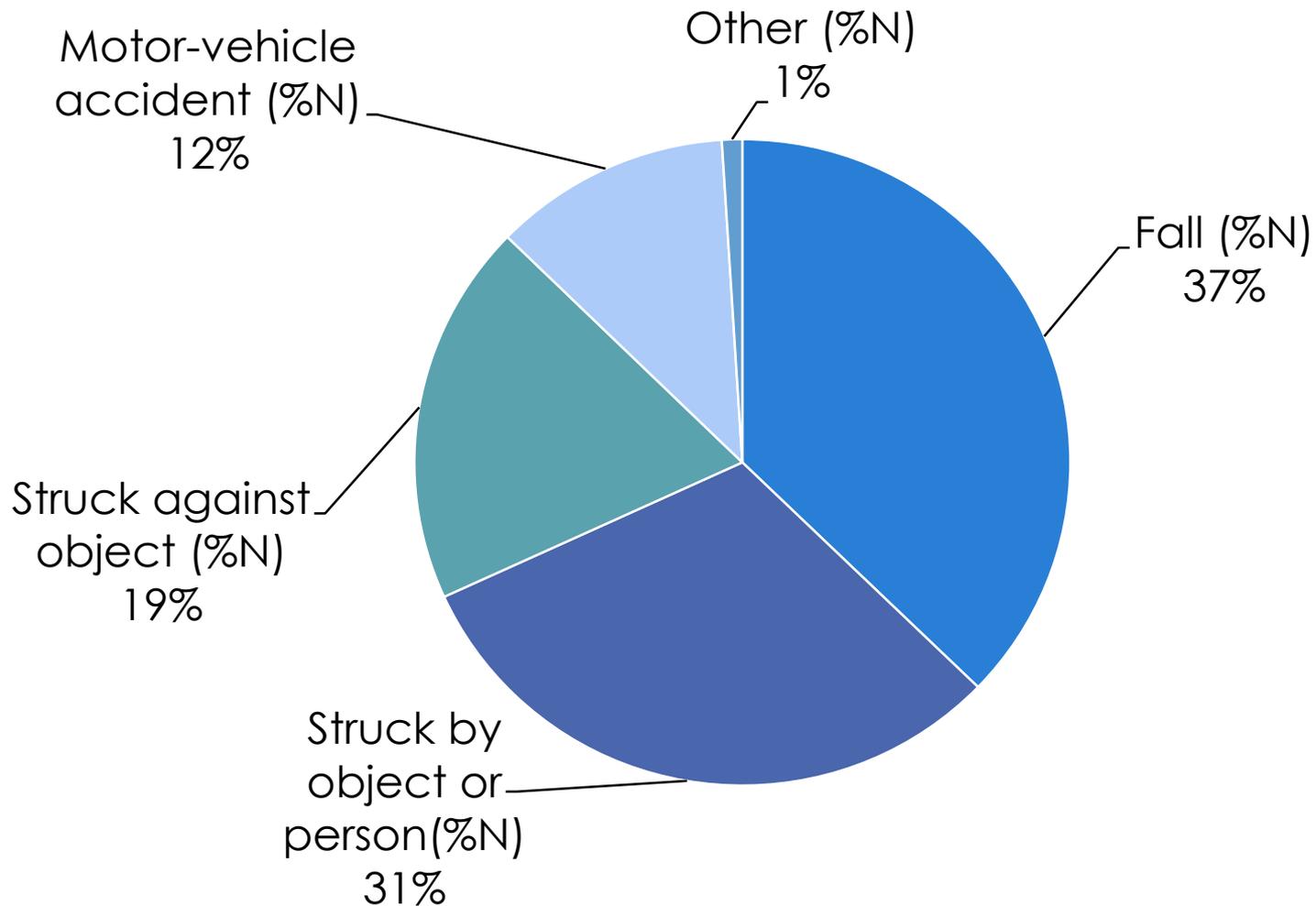


- N=94
- Median **time since injury**= 197 days (Q1-Q3: 139-416)
- Mean **age** (SD)=45.2±9.9
- N **males** (%)= 58 (62)
- N **married/common law** (%)= 69 (73)
- N w/ **dependent children in household** (%)= 55 (61)
- **Education, N(%):**
 - ≤high school=34 (36)
 - High school/college or prof degree= 32 (34)
 - ≥university= 24 (27)
- N **native language English** (%)= 77 (82)
- Mean **pre-disability weekly income** (SD)= \$1056 (510)

Pre-morbid diagnoses



Mechanism of mild wrTBI



Results



#MVCs in past 5 years	1	21.3%
	2	8.5%
	≥3	3.2%

Shift-work	47.9%	Rotating	84.4%	36.3% ¹
	25.5 % ¹	Night	15.6%	8.1% ¹

#work-related injuries in past 5 years	1	63.8%
	2	17%
	≥3	10.6%

Pre-/post-morbid sleep disorders	SA	10.6%
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Accident involvement due to sleepiness	Yes	8.5%
---	-----	------

Treated?	Yes	80%
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Gain weight since injury	Yes	68.5%
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Results



Work status	Disability	57%
	Part-time/full-time	43%

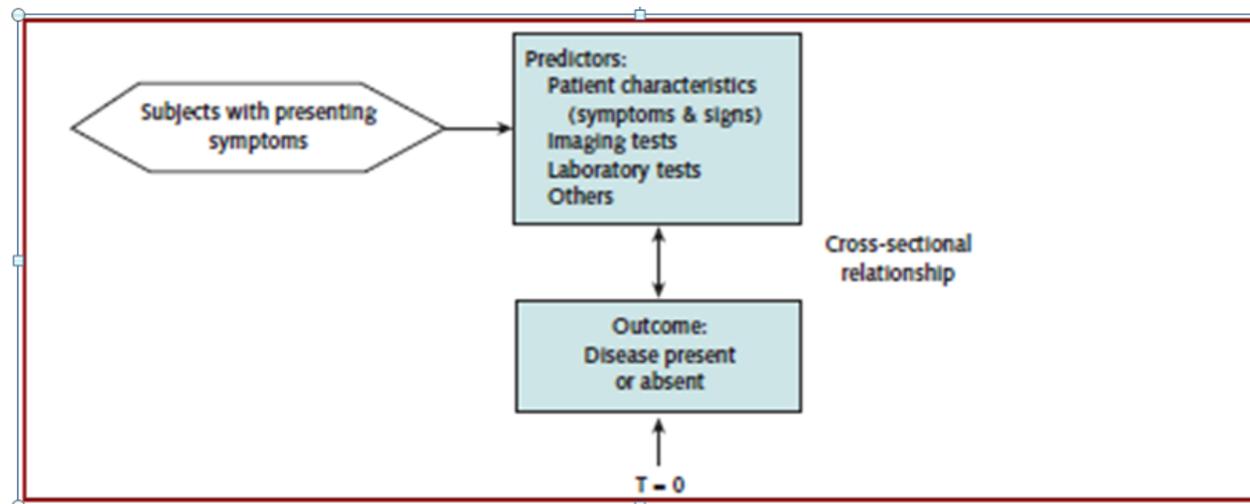
Tension with	Employer	36%
	WSIB	15%

GAF score	51-60	32%
	61-70	63%
	71-80	5.7%

Previous WSIB claims	Yes	9%
Family difficulties	Yes	62%

Methods: diagnostic modeling¹

- Diagnostic modeling study aims to derive a model by selecting the relevant variables and combining them statistically into a multivariable model
- We developed **frameworks** of outcomes (**chronic pain, fatigues/alertness/sleepiness, community (re)integration, work disability**) with **sleep/insomnia** as a primary hypothesized predictor
- We tested these frameworks in workers with established diagnosis of wr mTBI/concussion



Sleep and chronic pain

Observational Study

Medicine[®]

OPEN

Concussion/mild traumatic brain injury-related chronic pain in males and females: A diagnostic modelling study

Tatyana Mollayeva, MD, RST, RPSGT, PhD^{a,b,c,*}, J. David Cassidy, PhD, DrMedSc^{d,e},
Colin M. Shapiro, FRCPC, MBBCh, PhD^{f,g}, Shirin Mollayeva, HonsBSc, MSc student^h,
Angela Colantonio, OT (Reg.), PhD^{a,b,c}

Main objective:

- Investigate how sleep-related factors associate with chronic pain in males and females with wr mTBI

Hypothesis

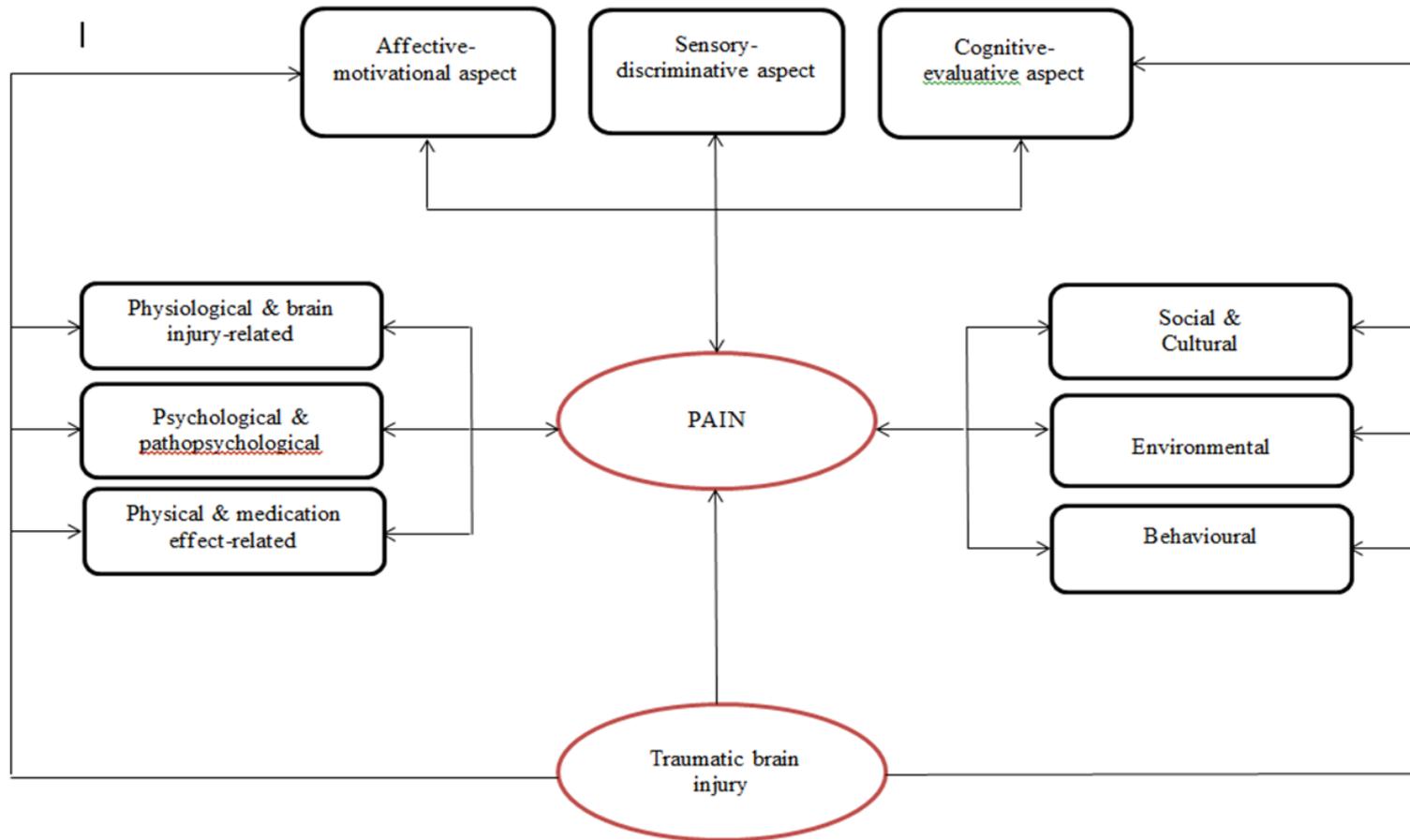


Figure 1. Multidimensional construct of pain in traumatic brain injury. Modified from Price (1999), Brennan, Carr & Cousins (2007), and Guindon & Hohmann (2009). Unidirectional arrows between constructs (i.e. circles) and from constructs to items (i.e. rectangles) represent reflective models, and from items to constructs, formative models. Bidirectional arrows represent a combination of reflective and formative elements.

Chronic pain in **males**: stepwise linear regression analysis procedure

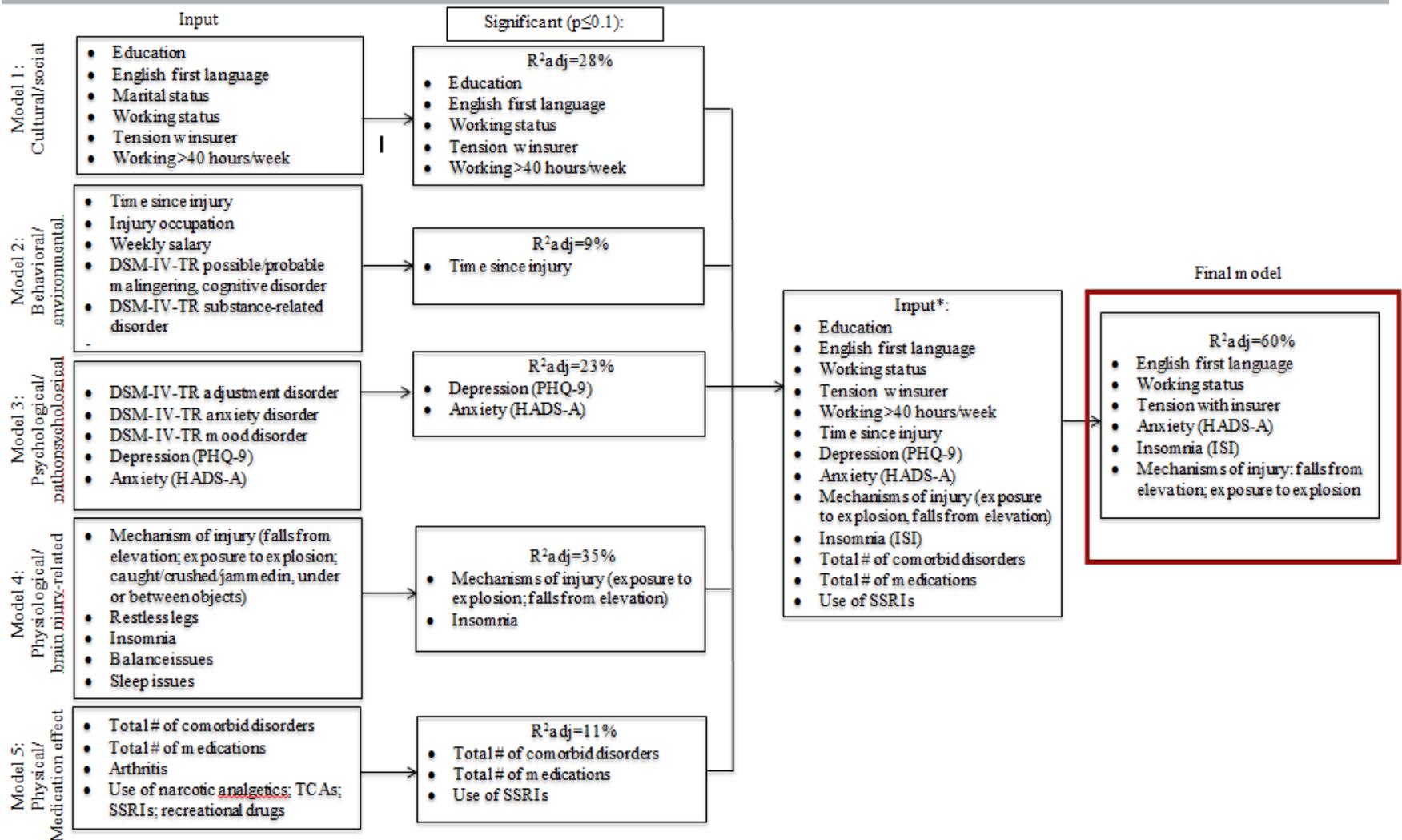


Figure 4. Flow diagram depicting the stepwise multiple regression analysis of pain in males *each model a ge-adjusted

Chronic pain in **females**: stepwise linear regression analysis procedure

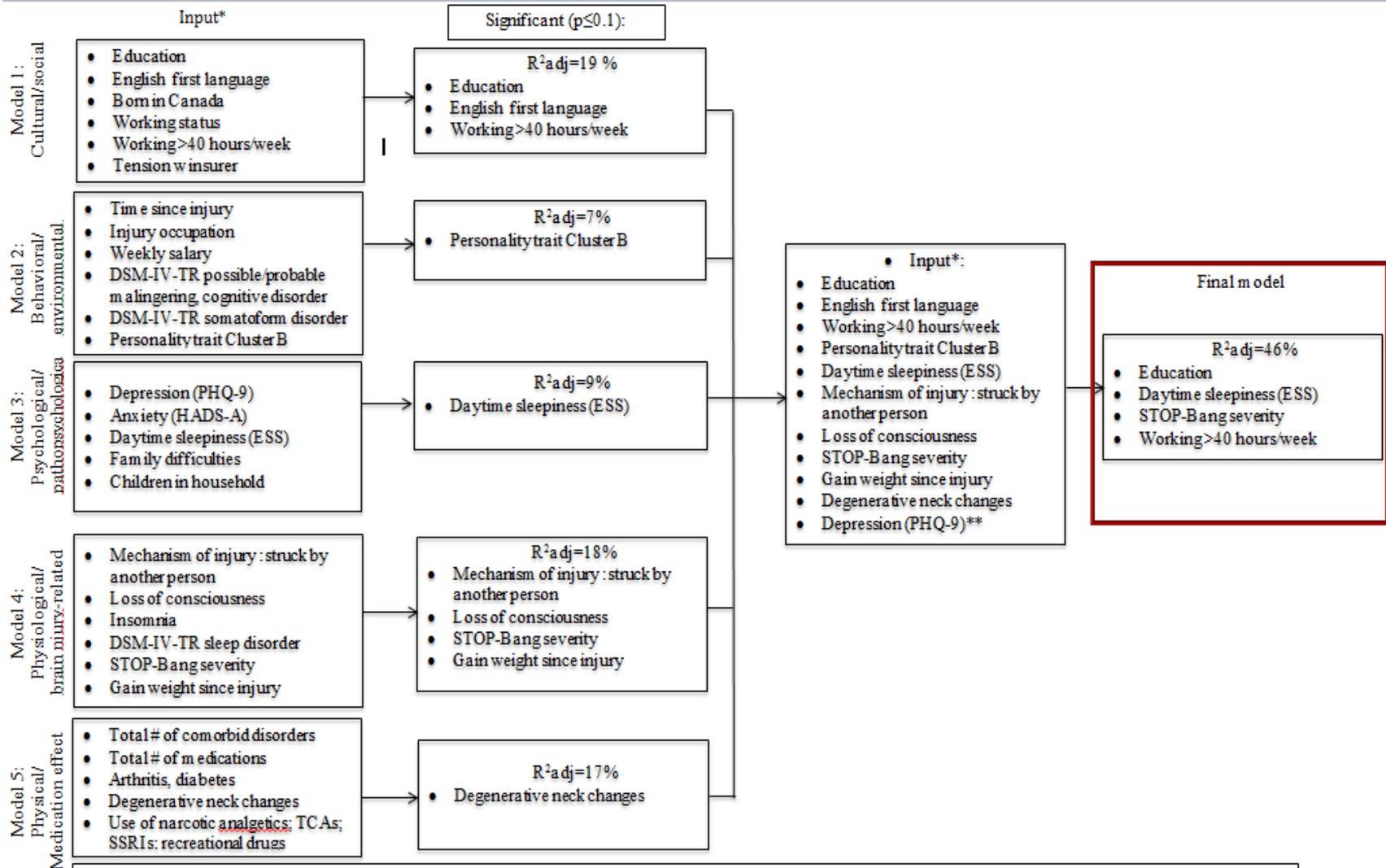


Figure 5. Flow diagram depicting the stepwise multiple regression analysis of pain in females; **each model age-adjusted** included due to consistently reported associations

Highlights



- Pain construct **complex** in wr mTBI/concussion

VARIABLES WITHIN	VARIANCE IN PAIN EXPLAINED, %	MALES, VARIANCE IN PAIN EXPLAINED, %	FEMALES, VARIANCE IN PAIN EXPLAINED, %
CULTURAL/SOCIAL	23	28	19
ENVIRONMENTAL/BEHAVIOURAL	11	9	7
PATHO-/PSYCHOLOGICAL	15	23	9
INJURY-RELATED/PHYSIOLOGICAL	21	35	18
PHYSICAL/MEDICAL	20	11	17
FINAL MODEL, FULLY ADJUSTED	34	60	46

- Most significant covariates of pain in **males**: **insomnia** (24.5%), mechanism of injury falls from elevation (11%); in **females**: lower education (18%) and **# of SRBD risk factors** (13.4%)
- Final models outlined several covariates, clinical and non-clinical, worthy of further study; multidisciplinary approach is required for the diagnosis and management of pain in wr-mTBI/concussion

Fatigue, alertness, sleepiness in wrTBI

Research



Assessment of Concussion/Mild Traumatic Brain Injury-Related Fatigue, Alertness, and Daytime Sleepiness: A Diagnostic Modelling Study

[Tatyana Mollayeva^{1,1-3}](#), [Colin M Shapiro^{4,5}](#), [J David Cassidy^{6,7}](#), [Shirin Mollayeva⁸](#), [Angela Colantonio¹⁻³](#)

10.4172/Neuropsychiatry.1000186 © 2016

Neuropsychiatry (London) (2016) 6(6), 525–543

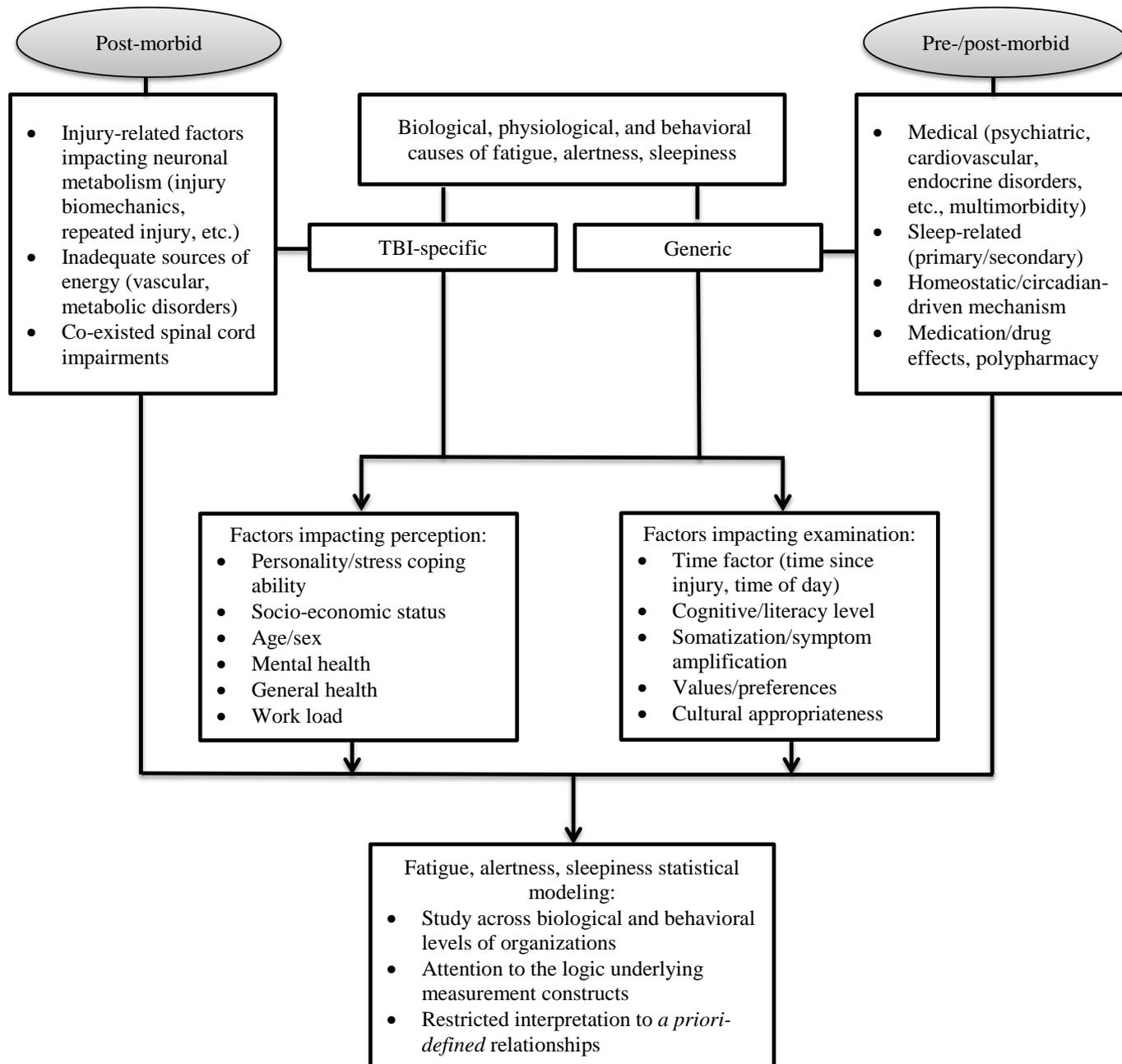
p- ISSN 1758-2008
e- ISSN 1758-2016

525

Main objective:

- To study the three perceived states among workers experiencing delayed recovery from concussion/mTBI





Highlights

- Fatigue, alertness, and sleepiness constructs **complex** in mTBI

VARIABLES WITHIN	FATIGUE, variance explained, %	ALERTNESS, variance explained, %	SLEEPINESS, variance explained, %
SOCIO-DEMOGRAPHIC	11	9	13
BRAIN-INJURY	29	15	20
MEDICAL	44	26	9
SLEEP-RELATED	31	21	10
SUBSTANCE/MEDICATION EFFECT	18	3	0

- Final models outlined several covariates, clinical and non-clinical, worthy of further study; multidisciplinary approach is required for the diagnosis and management of perceived states in chronic mTBI/concussion

Sleep and community (re) integration

Mollayeva et al. *BMC Neurology* (2015) 15:194
DOI 10.1186/s12883-015-0432-z



RESEARCH ARTICLE

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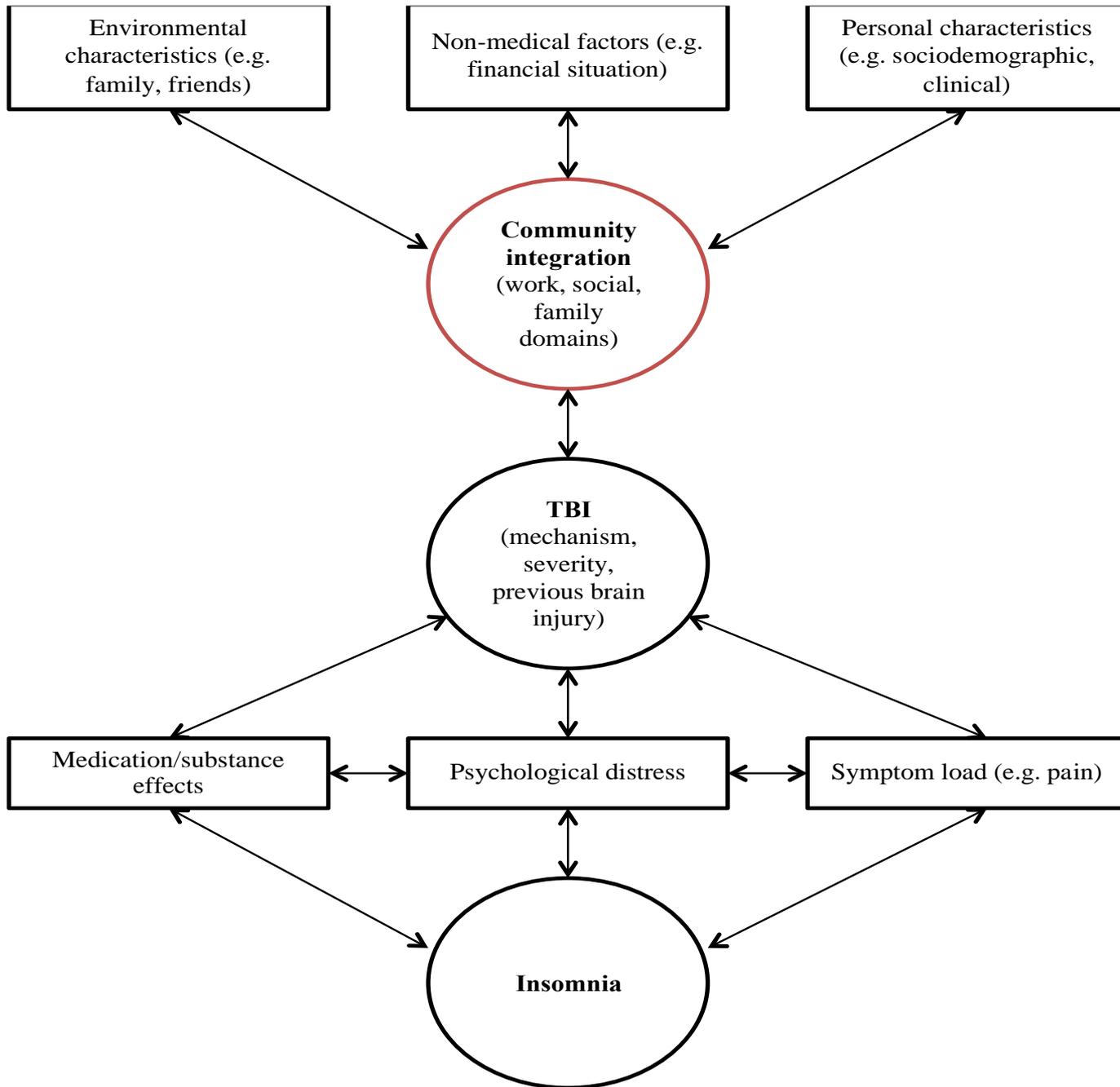
Modeling community integration in workers with delayed recovery from mild traumatic brain injury



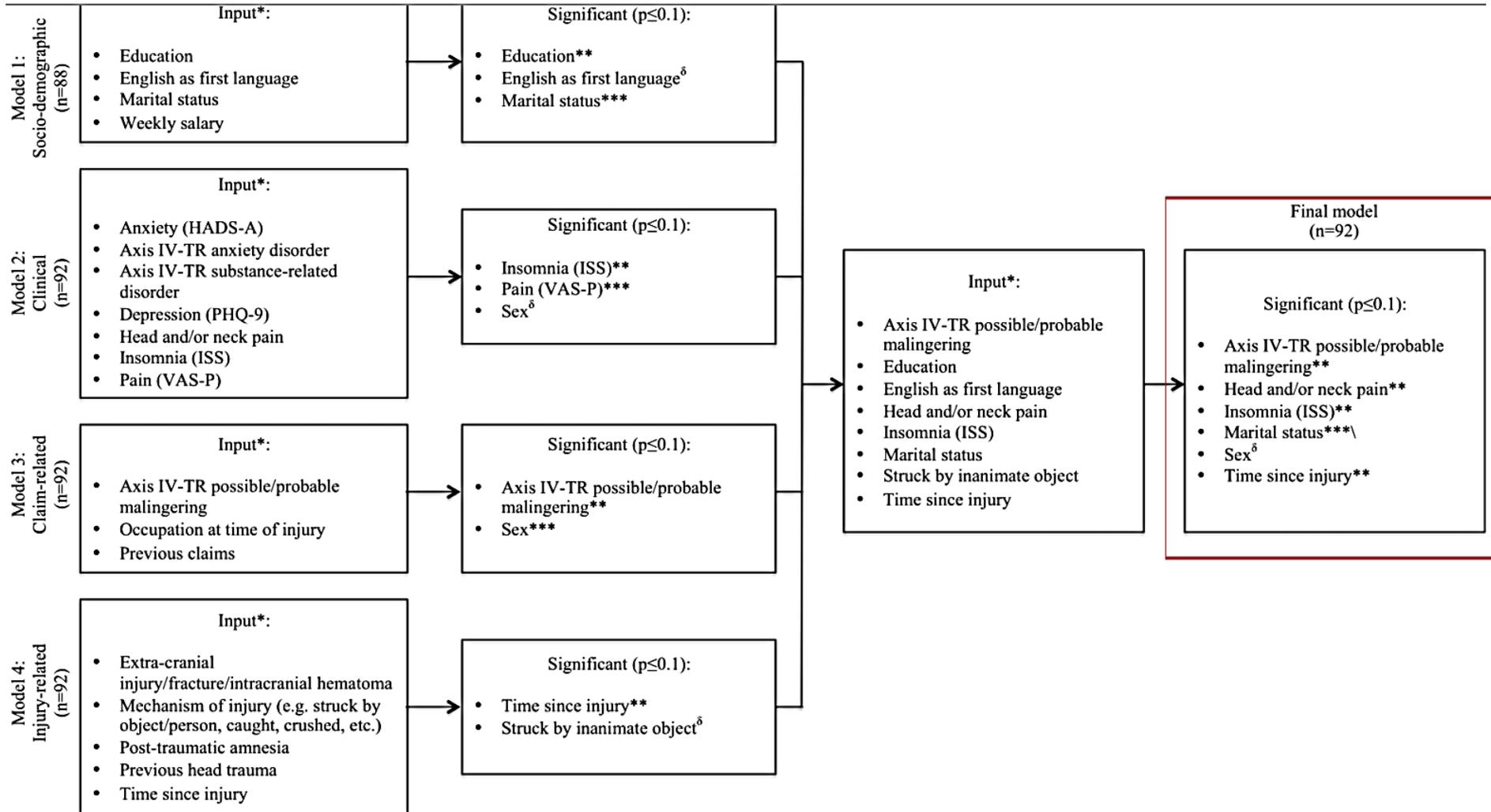
Tatyana Mollayeva^{1,2*}, Colin M. Shapiro^{3,4}, Shirin Mollayeva^{5,6}, J. David Cassidy^{7,8} and Angela Colantonio^{2,9}

Objectives:

- Develop model for the construct of community integration (CI) in TBI
- Investigate sleep in relation to CI in a sample of workers with delayed recovery from mTBI



Flow chart: stepwise multiple regression analysis procedure



Highlights

- Variables independently associated with community integration in a fully adjusted regression model:
 - ***Insomnia***
 - ***Head or neck pain***
 - ***Being married or in a relationship***
 - ***Time since injury***
 - ***Diagnosis of possible/probable malingering***
- CIQ total and subscale scores similar to mean scores at one year post injury in more severe TBI samples^{1,2}

¹Sander AM, Fuchs K L, High WM, Hall KM, Kreuzer JS, Rosental M. The Community Integration Questionnaire revisited: an assessment of factor structure and validity. Arch Phys Med Rehabil 1999;80: 1303-8.

²Seale GS, Caroselli JS, High WM Jr, Becker CL, Neese LE, Scheibel R. Use of the Community Integration Questionnaire (CIQ) to characterize changes in functioning for individuals with traumatic brain injury who participated in a post-acute rehabilitation programme. Brain Inj 2002;16: 955-67.

Sleep and perceived work disability

Sleep Medicine 20 (2016) 157–166



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Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep



Original Article

The relationship between insomnia and disability in workers with mild traumatic brain injury/concussion

Insomnia and disability in chronic mild traumatic brain injury

Tatyana Mollayeva^{a,b,c,*}, Brandy Pratt^d, Shirin Mollayeva^{e,f,g}, Colin M. Shapiro^{e,g,h}, J. David Cassidy^{d,i}, Angela Colantonio^{a,c,f,j}

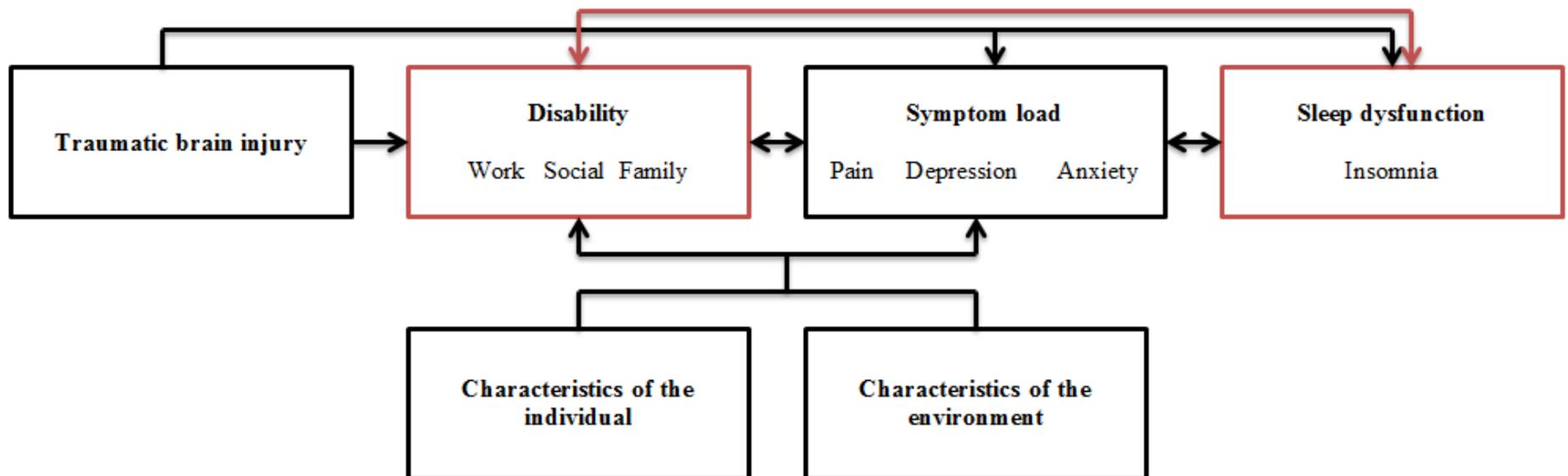


Main objective:

- Investigate how sleep dysfunction, characterized as insomnia, and other known factors, associate with work disability in persons with delayed recovery from mild wrTBI

Hypotheses

Figure: Hypothesized relationships related to mTBI disability outcome. Red colour indicates the primary hypothesis, previously unexplored. Black colour indicates other tested relationships, previously described in the literature



Results: logistic model work disability

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Wald χ^2 statistic	p-value
Insomnia Severity Score	1.21 (1.10, 1.34)	1.15 (1.02, 1.29)	5.22	0.022
Age (per 5 year increase)	1.05 (0.83, 1.33)	0.98 (0.75, 1.29)	0.07	0.790
Sex				
Male (ref)	1.00	1.00	0.01	0.914
Female	1.05 (0.40, 2.72)	0.86 (0.28,2.67)		
Work status				
Working part- full time(ref)	1.00	1.00	0.0003	0.061
On disability	2.67 (1.29, 7.89)	2.92 (0.96, 8.82)		
Depression Scale Score	1.17 (1.08,1.28)	1.11 (0.98, 1.25)	2.57	0.111
Anxiety Scale Score	1.16 (1.01-1.39)	1.16 (0.99,1.35)	3.67	0.067
Pain Rating Scale	1.04 (0.99, 1.20)	0.97 (0.84, 1.13)	2.72	0.710

Highlights

- The odds of perceiving higher **work disability** were greater in those with more severe clinical **insomnia**
- Previous confounders (depression, anxiety, pain) were not significant after full adjustment
- Results highlight focus on addressing **insomnia** in mild wrTBI

Understanding insomnia in wr mTBI



Contents lists available at [ScienceDirect](#)

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep



Original Article

Insomnia in workers with delayed recovery from mild traumatic brain injury

Tatyana Mollayeva^{a,b,c,*}, Shirin Mollayeva^{d,e,f}, Colin M. Shapiro^{d,f,g}, J. David Cassidy^{h,i,j},
Angela Colantonio^{a,e,k}

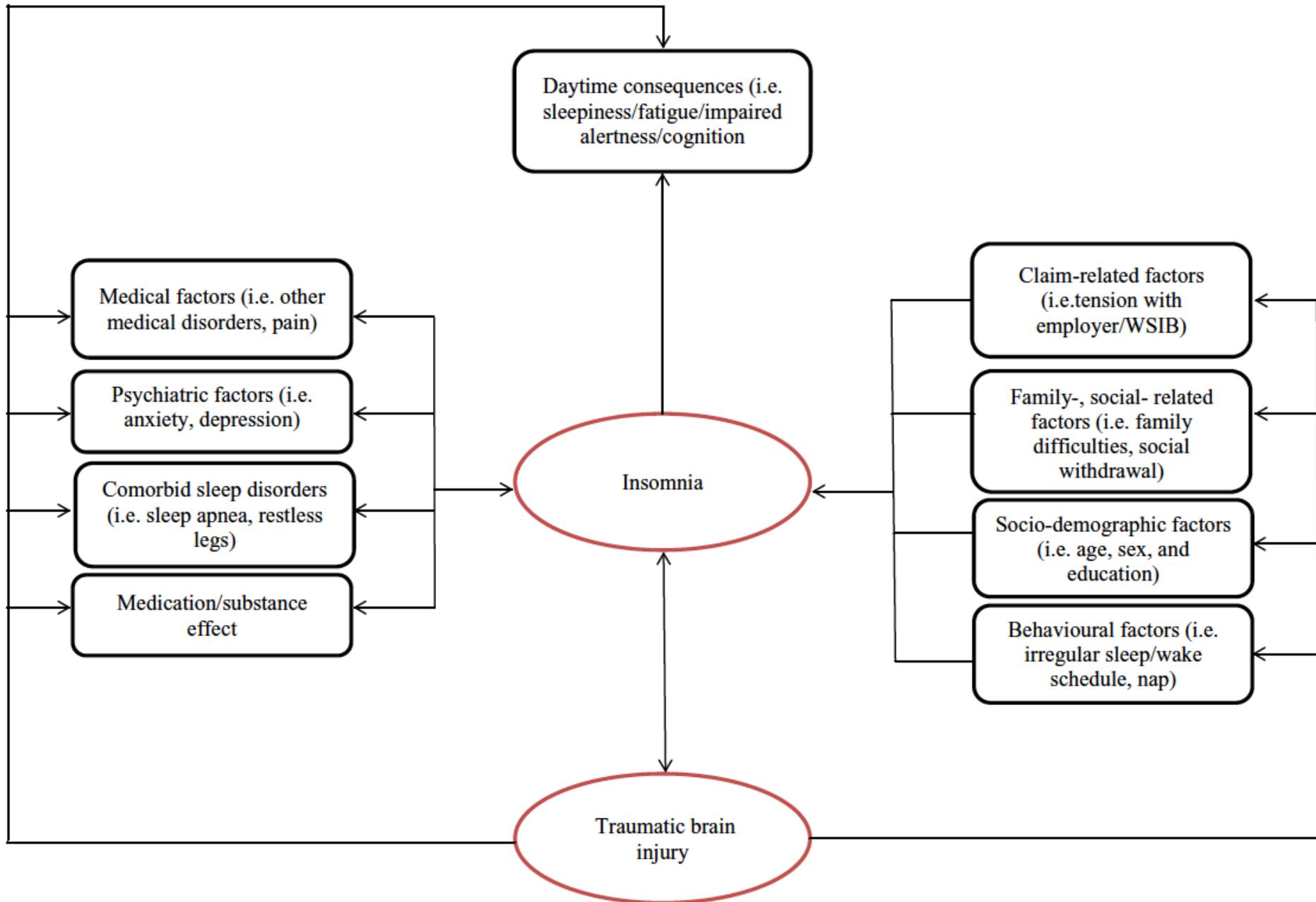
Objectives:

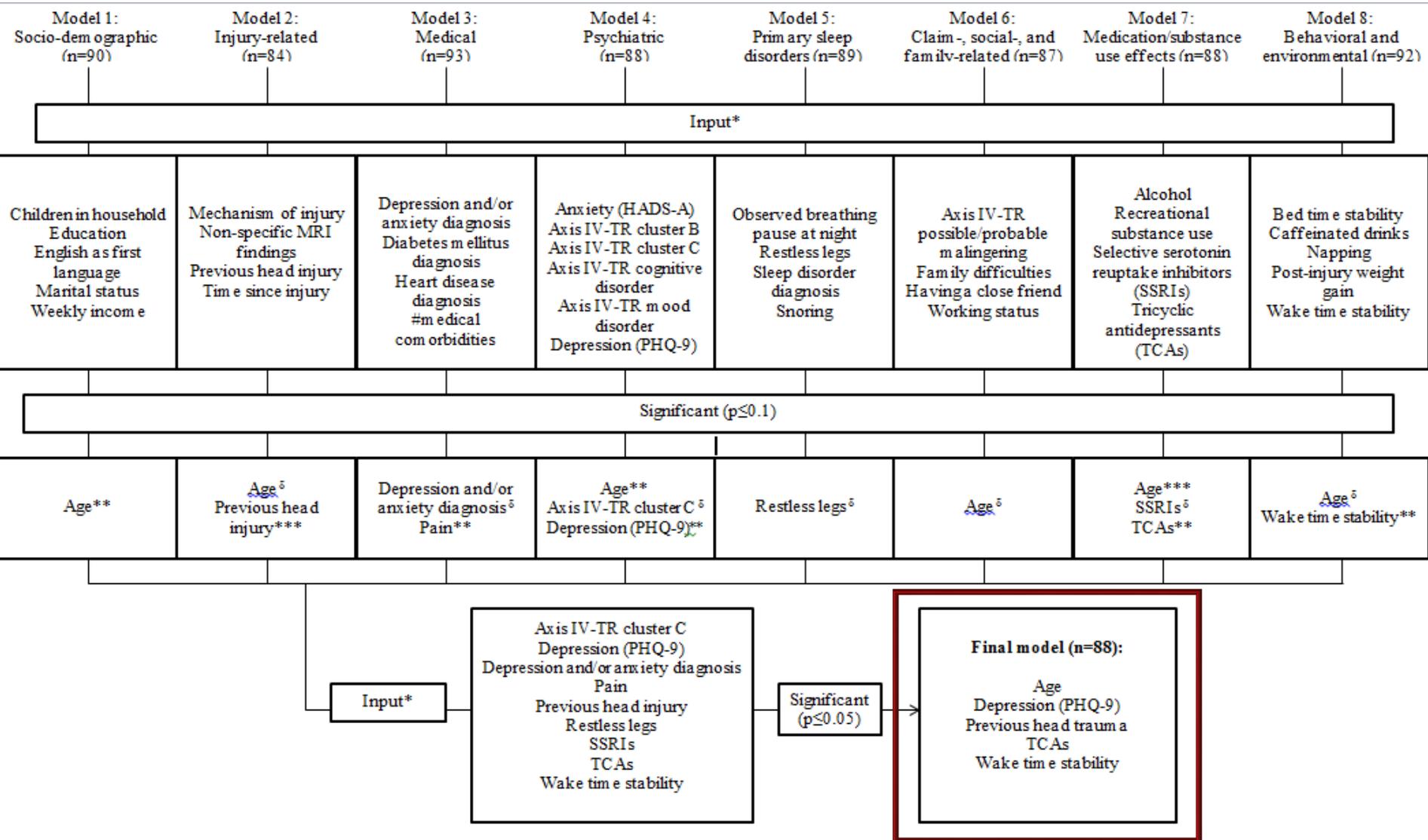
- Elucidate demographic, injury-related, clinical, psychosocial, and behavioural factors associated with insomnia in persons with mTBI

Insomnia



- Complaint of inadequate sleep despite adequate opportunity¹
- Classified according to nature of sleep disruption and duration¹:
 - Difficulty falling asleep
 - Difficulty maintaining sleep
 - Waking too early
 - Feeling unrefreshed upon awakening





Highlights

- Nearly 69% of workers with delayed recovery from mTBI had insomnia
- In a fully adjusted model insomnia associated with age, depression, previous head injury, and wake up timing instability=>majority of covariates are modifiable
- Multidisciplinary approach is required for proper differential diagnoses and management of insomnia

Limitations of studies 1-5

- We used patient-reported (PR) measures to study relevant outcomes in wr mTBI/concussion; non-response bias occurred at $\approx 5\%$ on average across all measures
- Preceding period of sleep deprivation in mTBI may change perception; longitudinal interplay between sleep and other variables remains to be determine
- Cross-sectional investigation – cannot provide causal evidence
- Sample representativeness

Prospective evaluation of sleep function in injured workers with mTBI

Sleep Medicine 34 (2017) 179–192



Contents lists available at [ScienceDirect](#)

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep



Original Article

Sleep stage distribution in persons with mild traumatic brain injury: a polysomnographic study according to American Academy of Sleep Medicine standards



Tatyana Mollayeva^{a, b, c, *}, Angela Colantonio^{a, e, j}, J. David Cassidy^{h, i}, Lee Vernichⁱ,
Rahim Moineddinⁱ, Colin M. Shapiro^{d, f, g}

Main objective:

- To examine deviations in sleep stage distribution in workers with mTBI relative to population age- and sex-specific norms, and the relationships between such deviations and brain injury-related, medical/psychiatric, and extrinsic factors

Hypothesis

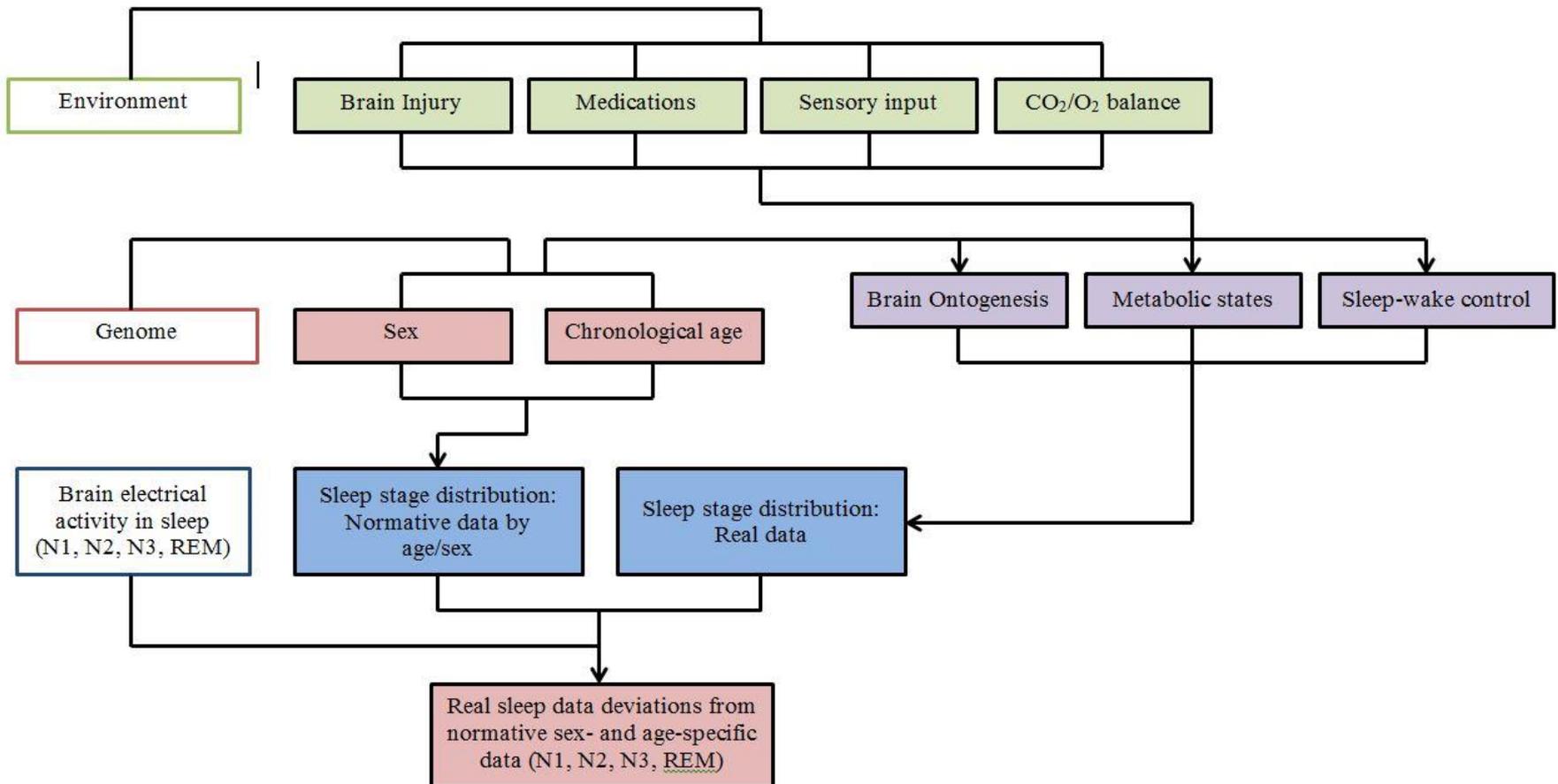
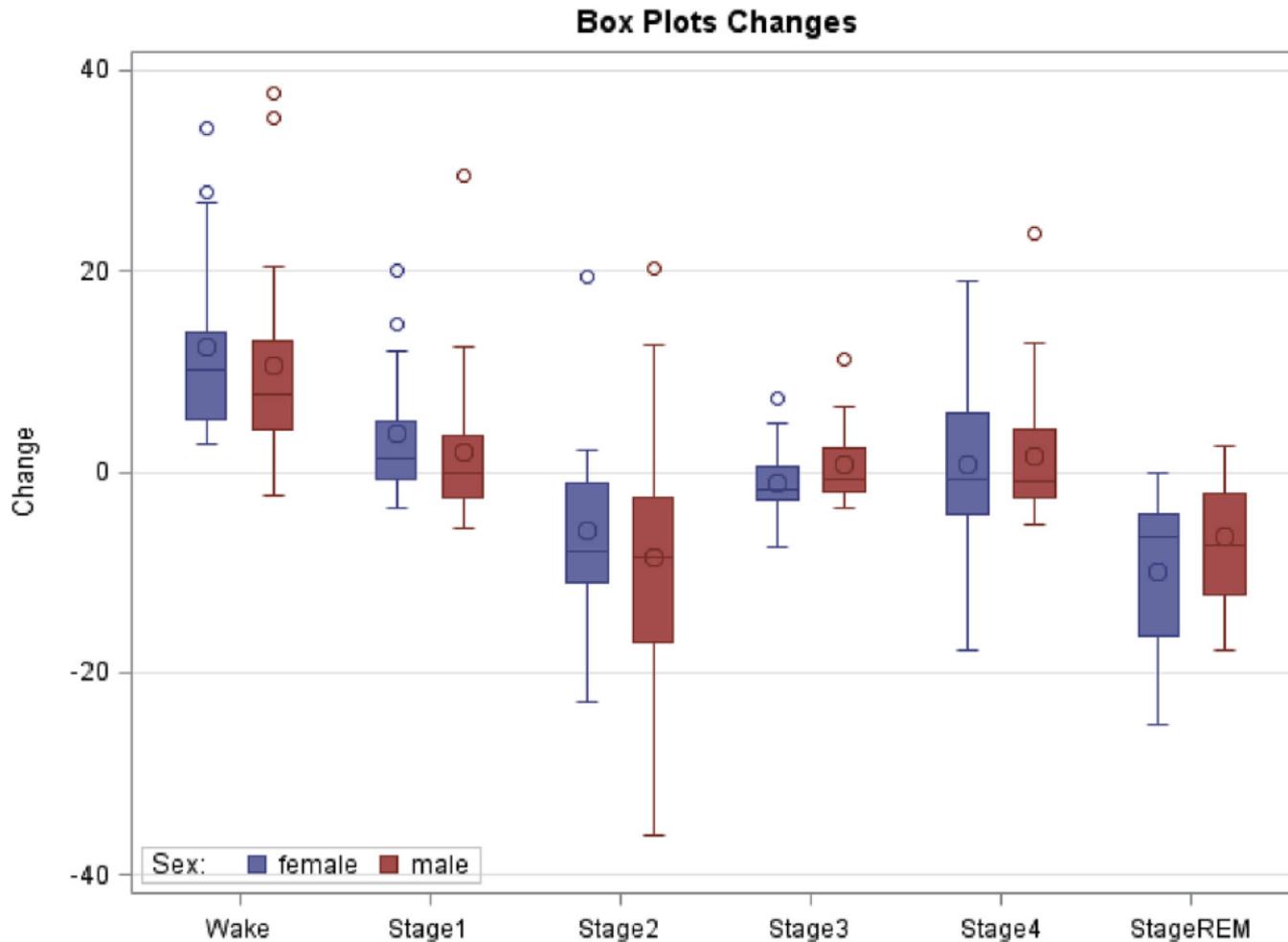


Fig1. Hypothesized relationships related to mTBI sleep stage distribution in comparison to sex- and age- specific normative data.

Sleep stage deviations in mTBI in comparison to age- and sex-specific normative data



Highlights

- Vs. population norms, mTBI group exhibited significantly higher **nocturnal wakefulness** (i.e., WASO) ($p < 0.0001$), lower **N2** ($p < 0.05$) and **REM** sleep (< 0.0001)
- In a fully adjusted models deviations in:
 - WASO associated with **DSM-IV-TR adjustment disorder** and **BMI**
 - N2 associated with **education level** and **insomnia**
 - REM associated with pre- sleep **period of wakefulness** and **benzodiazepine use**
- These changes related to patients' reports of **emotional and physical symptoms**
- ***Disruption of sleep stages is detrimental to mental and bodily functions***

Strength of the wr mTBI sleep research

- Studies are hypothesis-driven
- Interdisciplinary approach, crossing neural, psychosocial, clinical, and behavioural levels of complex constructs that could be context-dependent
- Diagnoses of work-related concussion/mTBI made by a team of clinicians trained in neurology, psychiatry, psychology and other relevant disciplines
- Our methodology approach identified novel previously-undescribed associations that could be replicated and worthy of further study

Key stakeholders in wr mTBI research/practice

- Healthcare providers
- Worker's compensation or disability insurers
- Employers
- Government agencies, labour union groups
- Injured workers, their families

Implications for healthcare providers

- Sleep is disturbed in patients with wr mTBI, associated with adverse outcomes
- The construct of sleep disturbance is complex
- The question of whether sleep dysfunction is the cause, the consequence, or develops on its own after injury as the person ages and more comorbid conditions accumulate, remains to be answered
- Timely and proper differential diagnosis followed by highly specific treatment necessary

Implications for occupational health & safety and rehabilitation

- The effects of a multidisciplinary approach to treatment and rehabilitation of persons with TBI are well documented, however rates of returning to and remaining at work at *197 days* post injury are still low (i.e., 57% remain on full disability)
- Prevention efforts are extremely important:
 - **Primary** (e.g., identification of workplace hazards)
 - **Secondary** (e.g., screening for sleep dysfunction)
 - **Tertiary** (e.g., appropriate treatment of associated disorders, including sleep disorders, and return to the workplace, with change of job duties if necessary)

Implications for the employer

- In Canada, past decades saw labour force growth by 21.7%, an estimated half comprising shift workers
- Overall number of workplace injuries reported declined during this period, rate of injury remained constant for shift workers
- This study – ~50% (n=110) workers with head trauma were performing shift work at the time of their injury, higher than reported for the entire Canadian workforce
- ***New hypotheses – call for comprehensive investigation of the relationship between circadian displacement due to pre-morbid shift work and variables leading to workplace injury***

Implications for the insurer

- Sleep functioning post injury has important implications for health and safety at the workplace; rarely investigated in injured workers
- Our research raises awareness on the prevalence and range of sleep disorders experienced by workers with delayed recovery from mTBI, and highlights a potential link to shift work based on the proportion of shift workers in the study sample

Implications for aging with TBI at the workplace

- Sleep dysfunction is common in our sample of middle aged workers with mTBI and may go uninvestigated
- Age was identified as a covariate for insomnia as well as sleep-related breathing disorder
- Awareness of one's own sleep quality and investigation by a professional can promote maximal recovery and potentially keep future accidents from occurring at the workplace and beyond

THANK YOU

Acknowledgements: Ontario men and women with wr
mTBI/concussion who participated in sleep research



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