CHALLENGES IN MEASURING FIREFIGHTER HEALTH AND WORK OUTCOMES

Joy C MacDermid

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Learning Objectives

At the conclusion of this presentation, participants will be able to:

1) Describe difficulty in measuring firefighters abilities and at work limitations.

2) Explain the development of a new tool to assess firefighter-specific work limitations.

Caveat – Focus on what we have learned

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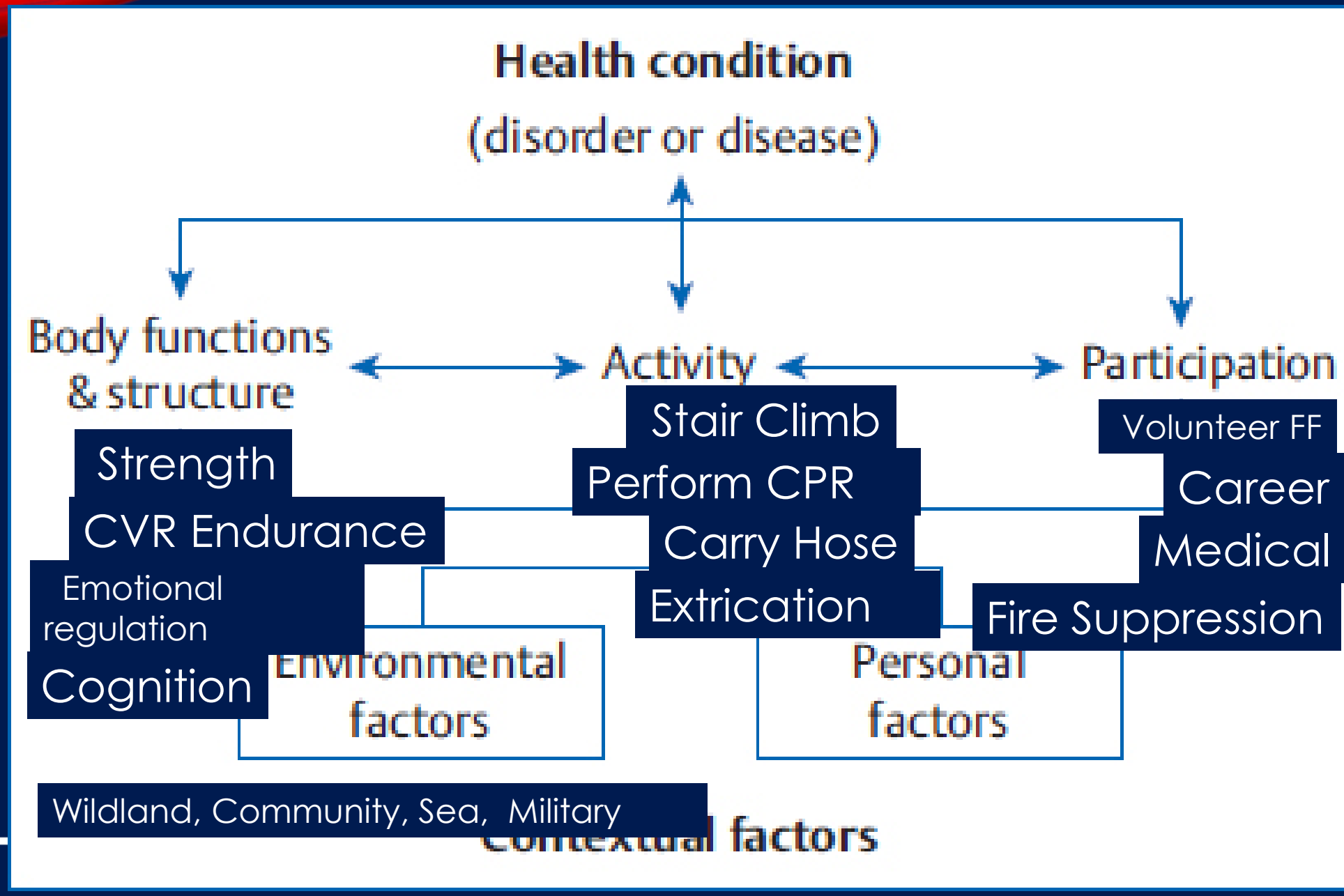
ONE FRAME-WORK OUTCOMES OF INTEREST



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BODY STRUCTURE AND FUNCTION

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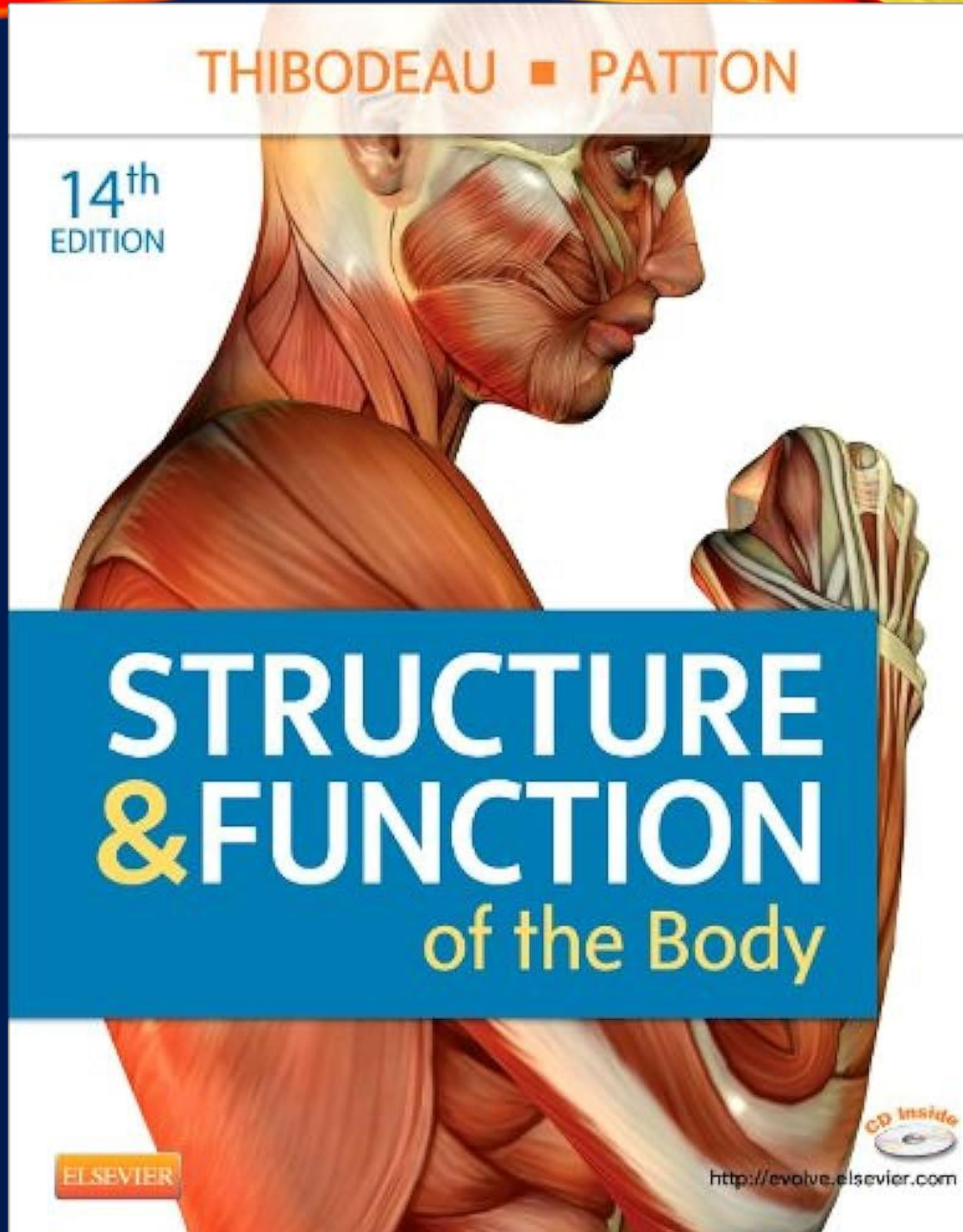

BODY STRUCTURE AND FUNCTION IMPAIRMENTS

Body structure- parts

- BMI
- Imaging
- Anthropometrics

Body Function- processes

- Vo2 Max/Submax fitness
- Muscle strength
- Muscle endurance/control
- Vision/Hearing
- Respiratory Rate
- Executive Function
- Emotional Control
- Cognition
- Pain

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ACTIVITY (LIMITATIONS)

Self-reported Activity

Measured Activity

- Stair-Climb
- Lift
- Carry
- Move in Tight space
- Communicate

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PARTICIPATION (RESTRICTIONS)

- Work type
  - Line of duty
  - Modified
- Work Roles
  - Components
  - Accommodations
- Work Limitations
  - Specific limitations (which may need accommodation)
- Work/Functional Capacity

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HOW TO FIREFIGHTERS COMPARE TO NORMS?

International Journal of Occupational Safety and Ergonomics

ISSN: 1080-3548 (Print) 2376-9130 (Online) Journal homepage: https://www.tandfonline.com/loi/tose20

Comparison of Canadian firefighters and healthy controls based on submaximal fitness testing and strength considering age and gender

Goris Nazari, Joy C. MacDermid, Kathryn E. Sinden & Tom J. Overend

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VERSUS NORMS…

Higher strength

Especially in women

No difference in CVR

Table 1. Demographic characteristics – firefighter and healthy participants.

Demographic	Male firefighters	Male healthy	Female firefighters	Female healthy
Sample size	46	20	3	20
Age (years)	33.48 ± 9.42	39.00 ± 11.00	36.00 ± 5.00	39.00 ± 11.00
Height (m)	1.82 ± 0.072	1.78 ± 0.06	1.69 ± 0.05	1.69 ± 0.05
Weight (kg)	91.61 ± 12.60	81.40 ± 8.02	71.00 ± 5.20	68.80 ± 13.17
Body mass index	27.71 ± 3.54	25.58 ± 2.26	24.86 ± 3.11	24.12 ± 4.62
Resting heart rate (bpm)	73.76 ± 10.78	71.85 ± 8.00	76.67 ± 10.07	72.85 ± 6.54
85% heart $rate_{max}$ (bpm)	158.52 ± 8.04	153.20 ± 9.61	156.33 ± 4.50	153.70 ± 9.49
V_{O2max} ($ml \cdot kg^{-1} \cdot min^{-1}$)	40.54 ± 6.38	38.28 ± 7.33	36.70 ± 2.17	34.01 ± 9.21
NIOSH lower limb strength (kg) [21]	140.48 ± 26.70	n/a	107.00 ± 26.51	n/a
Combined grip strength (kg)	118.14 ± 17.60	103.55*	80.833 ± 16.07	57.25**

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SELECTION BIAS

Firefighters START their career healthier than general population but this varies by

- body function

- sex

can be less than "normal" but less than they used to be

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REVIEW

Quantifying physiological responses during simulated tasks among Canadian firefighters: A systematic review and meta-analysis

Goris Nazari[a], Steve Lu[b] and Joy C. MacDermid[a]

DOES SIMULATED FIREFIGHTING TEST HIGH LEVEL ABILITY ?

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Table 3. Meta-analyses of percentage of maximum heart rate by maximal tes[illegible] during simulated [illegible]efighting tasks

Study	Firefighting Tasks	Sample	HR	HR_{max}	% HR_{max}	95% CI
All participants (N = 296)						
Williams-Bell[11]	High-rise stair climb — Ascent	36	167	183	91.00	86.00–95.00
Williams-Bell[11]	High-rise stair climb — Descent	36	156	183	85.00	79.00–90.00
Williams-Bell[11]	Fifth-floor search and rescue	36	160	183	87.00	82.00–92.00
Williams-Bell[10]	Subway scenario	36	138	184	75.00	68.00–81.00
Petersen & Dreger[13]	Two fire-rescue scenarios	25	154	194	79.00	73.00–85.00
Dreger & Petersen[12]	Canadian Forces/DND FFT	53	170	188	90.00	85.00–94.00
Petersen[15]	SFWC	17	173	192	90.00	85.00–94.00
Williams-Bell[16]	Candidate Physical Ability Test	57	170	188	90.00	85.00–94.00
Random-effects model, heterogeneity I^2 = 80.0%					86.00	82.00–90.00
Subgroup analysis by sex: men (n = 75)						
Petersen & Dreger[13]	Two fire-rescue scenarios	13	154	194	79.40	73.00–85.00
Dreger & Petersen[12]	Canadian Forces/DND FFT	30	169	189	89.30	84.00–93.00
Williams-Bell[16]	Candidate Physical Ability Test	32	169	188	90.00	85.00–94.00
Random-effects model, heterogeneity I^2 = 80.0%					86.00	79.00–92.00
Subgroup analysis by sex: women (n = 49)						
Petersen & Dreger[13]	Two fire-rescue scenarios	12	155	196	79.00	73.00–85.00
Dreger & Petersen[12]	CF–DND FFT	23	171	187	91.00	86.00–95.00
Williams-Bell[16]	Candidate Physical Ability Test	14	171	188	91.00	86.00–95.00

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Simulated firefighting is physically demanding

Variable performance

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Table 4. Meta-analyses of percentage of VO_{2max} (ml/kg/min) during sim

Study	Firefighting Tasks	Sam	VO_2	VO_{2max}	% VO_{2m}	95% CI
All participants (N = 210)						
Williams-Bell[11]	High-rise stair climb — ascend	36	38.30	51.40	75.00	51.00–98.00
Williams-Bell[11]	High-rise stair climb — descent	36	27.60	51.40	54.00	34.00–74.00
Williams-Bell[11]	Fifth-floor search & rescue	36	34.10	51.40	66.00	44.00–89.00
Petersen & Dreger[13]	Two fire-rescue	25	26.60	44.50	60.00	37.00–82.00
Williams-Bell[16]	Candidate Physical Ability Test	57	37.55	52.45	72.00	49.00–94.00
Harvey[18]	Firefighting Simulation Circuit	20	31.80	48.12	66.00	43.00–89.00
Random-effects model, heterogeneity I^2 = 22.00%					65.00	59.00–71.00
Subgroup analysis by sex: men (n = 57)						
Petersen & Dreger[13]	Two fire-rescue	13	27.10	44.20	61.30	45.50–75.60
Williams-Bell[16]	Candidate Physical Ability Test	32	38.70	53.00	73.00	59.10–84.30
Harvey[18]	Firefighting Simulation Circuit	12	34.20	50.30	68.00	53.30–80.40
Random-effects model, heterogeneity I^2 = 0.00%					68.00	56.00–75.00
Subgroup analysis by sex: women (n = 34)						
Petersen & Dreger[13]	Two fire-rescue	12	26.1	44.7	58.40	42.70–72.90
Williams-Bell[16]	Candidate Physical Ability Test	14	36.6	51.9	70.50	56.20–82.40
Harvey[18]	Firefighting Simulation Circuit	8	29.2	45.57	64.10	48.50–77.70
Random-effects model, heterogeneity I^2 = 0.00%					64.00	56.50–72.00

Note: VO_2 = oxygen consumption; VO_{2max} = maximal oxygen consumption; VO_{2max} percentage of maximal oxygen consumption.

DOES PHYSICAL FITNESS PREDICT WORK FUNCTION?

Volume 2018, Article ID 3234176, 7 pages
https://doi.org/10.1155/2018/3234176

Hindawi

Research Article

The Relationship between Physical Fitness and Simulated Firefighting Task Performance

Goris Nazari,[1] **Joy C. MacDermid**,[1,2] **Kathryn E. Sinden**,[3] **and Tom J. Overend**[1]

[1]*Health & Rehabilitation Science, Physiotherapy, Western University, London, ON, Canada*

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HIGH EXERTION BUT SELF RATINGS OF EFFORT LOW

Table 2: Firefighters' physiologic responses and task completion times.

Variable	*n*	Mean	SD	Max
Heart rate at hose drag (bpm)	49	163.00	16.00	195.00
Respiratory rate at hose drag (brpm)	49	27.00	4.00	40.00
HR-max% at hose drag (HR-max%)	49	88.00	8.00	106.00
Rating of perceived exertion hose drag (0–10)	49	1.78	1.10	5.00
Time elapsed to complete hose drag (seconds)	49	59.00	15.00	100.00
Heart rate at stair climb (bpm)	49	166.00	13.00	197.00
Respiratory rate at stair climb (brpm)	49	31.00	4.00	41.00
HR-max% at stair climb (%)	49		7.00	102.00
Rating of perceived exertion stair climb (0–10)	49	2.70	1.40	6.00
Time elapsed to complete stair climb (seconds)	49		14.50	93.00

LOW CORRELATION TO TASKS

Table 3: Intercorrelations among firefighters' fitness parameters and individual task completion times.

Variable	Hose drag (r)	Stair climb (r)
VO_{2max} (ml/kg/min)	-0.30^{**}	-0.31^{**}
NIOSH lower limb strength (kg)	-0.20^{**}	0.20
Combined grip strength (kg)	-0.20^{**}	0.10
Left grip strength (kg)	-0.10^{**}	0.10
Right grip strength (kg)	-0.25^{**}	0.10

$^{**}p < 0.05$

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AGE AND GRIP STRENGTH PREDICTED HOSE DRAG 24%

Table 4: Regression model for factors predicting hose drag completion times.

Label	Coefficient	SE	p	Part-squared	Model r^2	Model SE
Model 1						
Intercept	26.51	22.70	-	-	0.24	13.55
Age	0.48	0.23	0.03	0.081		
Right grip strength	−0.77	0.35	0.03	0.086		
Left grip strength	0.54	0.36	0.13	0.042		
Sex	5.23	9.10	0.57	0.005		
Resting HR	0.36	0.19	0.065	0.064		

SE: standard error.

LEG STRENGTH AND AGE PREDICT HIGH RISE PACK 25%

Table 5: Regression model for factors predicting stair climb with high-rise pack completion times.

Label	Coefficient	SE	p	Part-squared	Model r^2	Model SE
Model 1						
Intercept	0.13	21.00	-	-	0.25	13.10
NIOSH	0.21	0.07	0.005	0.147		
Age	0.46	0.22	0.030	0.077		
Sex	–10.80	8.22	0.190	0.029		
Resting HR	0.33	0.18	0.070	0.055		

SE: standard error.

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WHAT ABOUT ERGONOMIC ASSESSMENTS

WORKPLACE HEALTH & SAFETY December 2023

RESEARCH ARTICLE

Posture Evaluation of Firefighters During Simulated Fire Suppression Tasks

Tara Kajaks, PhD[1], Christina Ziebart, PT, PhD[2], Vickie Galea, PhD[3], Brenda Vrkljan, OT, PhD[3], and Joy C. MacDermid, PT, PhD[2,3,4]

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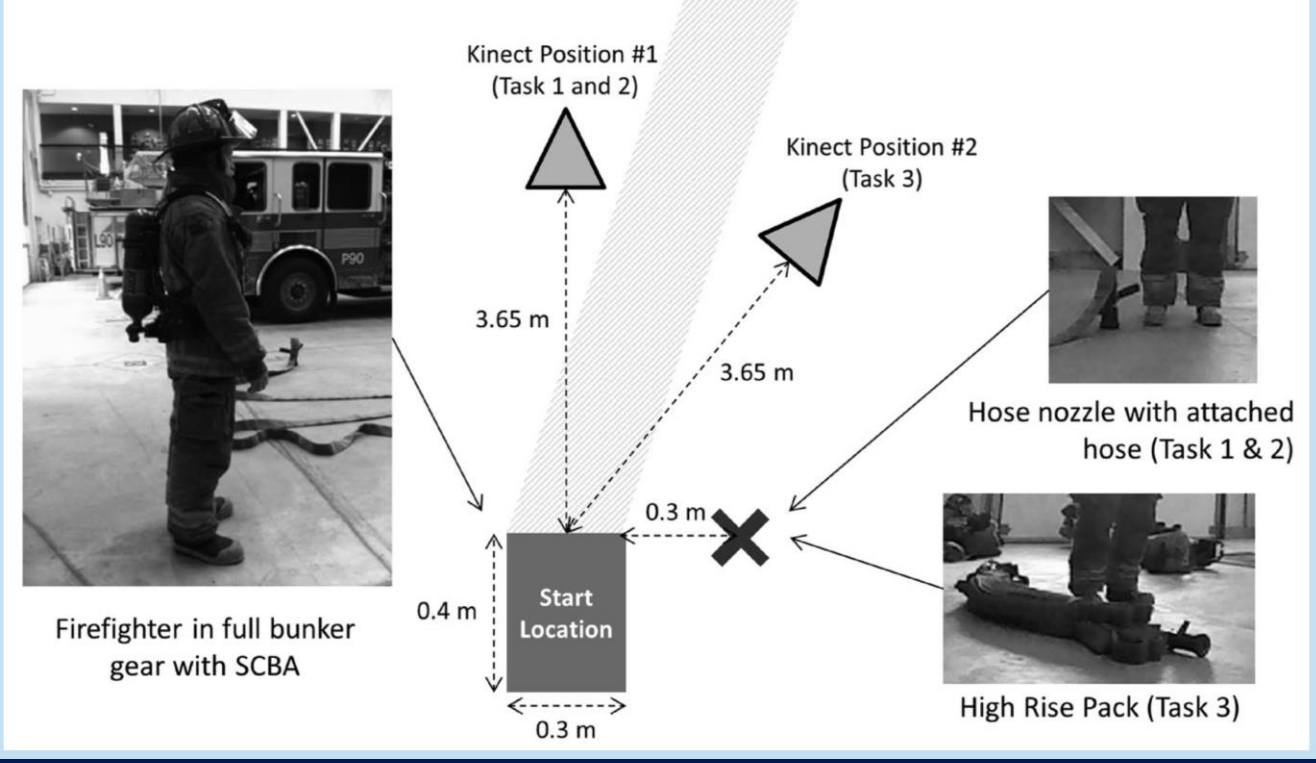

Figure 2. Sample images of the (A) hose drag (Task 1), (B) hose pull (Task 2), and (C) high-rise pack lift and carry (Task 3) task

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OVAKO WORKING POSTURE ANALYZING SYSTEM (OWAS)

- Ergonomic Assessment focus on "targets" for therapeutic intervention not change over time

- Difficult to change firefighting tasks

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WHAT ABOUT REAL TASK MOTION ANALYSIS?

Journal of Ergonomics

Sinden et al., J Ergonomics 2016, 6:1
http://dx.doi.org/10.4172/2165-7556.1000145

Research Open Access

Evaluating the Reliability of a Marker-Less, Digital Video Analysis Approach to Characterize Fire-fighter Trunk and Knee Postures During a Lift Task: A Proof-of-Concept Study

Kathryn E Sinden[1*], Joy C MacDermid[1-3], Thomas R Jenkyn[4,5], Sandra Moll[1] and Robert D'Amico[6]

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CHALLENGES

- Equipment
- Context
- Complex Motion
- Teamwork

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DARTFISH…. VIDEO BASED MOVEMENT ANALYSIS

Posture	ICC2, 1	95% CI	SEM	MDC90
Knee Angle	0.85	0.50, 0.96	4.5°	10.5°
Trunk Angle (Tracked)	0.72	0.30, 0.91	8.9°	20.8°
Relative Hip Movement	0.84	0.52, 0.95	2%	5%
Trunk Angle (single frame)	0.97	0.89, 0.99	2.5°	5.8°
Knee Angle (single frame)	0.97	0.91, 0.99	2.6°	6.1°

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VIDEO BASED MOTION ANALYSIS

Pros

- Can do real world assessments
- Ease of data collection
- Low cost
- Built in tools, applications
- AI (Mediapipe) and more sophisticated link camera systems

Cons

- Perspective error
- Time intensive analysis
- Challenges in tracking complex out of plane movement
- Lower precision
- Hard to convince reviewers who used 3D motion analysis than the data is rigourous

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MEASURING WORK LIMITATIONS

GENERIC WLQ

Face validity

In the **past 4 weeks**, how much of the time did your physical health or emotional problems **make it difficult** for you to do the following?

DIFFICULT	All of the Time (100%)	Most of the Time	Half of the Time (50%)	Some of the Time	None of the Time (0%)	Does Not Apply to My Job
a. Get to work on time	☐1	☐2	☐3	☐4	☐5	☐6
b. Stick to a routine or schedule without having to rearrange your work tasks	☐1	☐2	☐3	☐4	☐5	☐6
c. Work without taking frequent rests or breaks to avoid discomfort	☐1	☐2	☐3	☐4	☐5	☐6
d. Work the required number of hours	☐1	☐2	☐3	☐4	☐5	☐6

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PTJ Physical Therapy & Rehabilitation Journal

APTA American Physical Therapy Association

Volume 91, Issue 2
1 February 2011

JOURNAL ARTICLE

Validity and Responsiveness of Presenteeism Scales in Chronic Work-Related Upper-Extremity Disorders FREE

Jean-Sébastien Roy ✉, Joy C. MacDermid, Benjamin C. Amick, III, Harry S. Shannon, Robert McMurtry, James H. Roth, Ruby Grewal, Kenneth Tang, Dorcas Beaton Author Notes

Physical Therapy, Volume 91, Issue 2, 1 February 2011, Pages 254–266, https://doi.org/10.2522/ptj.20090274

Published: 01 February 2011 **Article history** ▾

IN MIXED GROUP OF WSIB CASES

The WLQ-25 and RA-WIS provide different information from that provided by pain and disability measures.

They discriminate among functional out-come subgroups and detect improvement over time in people with chronic work-related upper-extremity disorders.

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LACK OF FIT IN INJURED WORKERS

The WLQ-25 did not fit with the Rasch model

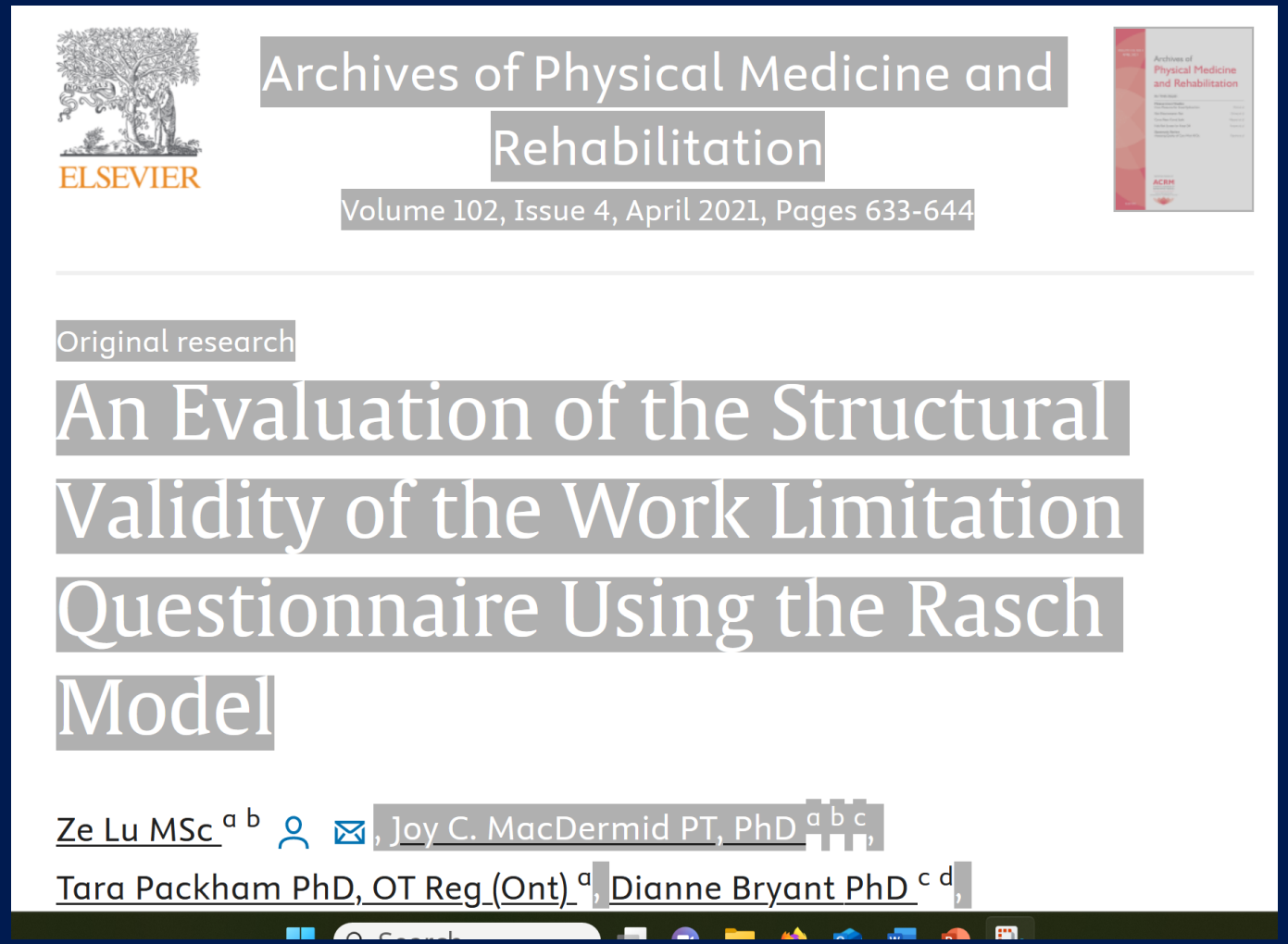
most of the thresholds were disordered.

- After extensive modifications,

item reduction (6 items)

response merging (9 items)

only 3 subscales FIT



ELSEVIER

Archives of Physical Medicine and Rehabilitation

Volume 102, Issue 4, April 2021, Pages 633-644

Original research

An Evaluation of the Structural Validity of the Work Limitation Questionnaire Using the Rasch Model

Ze Lu MSc [a b], Joy C. MacDermid PT, PhD [a b c],

Tara Packham PhD, OT Reg (Ont) [a], Dianne Bryant PhD [c d],

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CONSTRUCT VALIDITY- KNOWN GROUP DIFFERENCES

Hindawi
Rehabilitation Research and Practice
Volume 2020, Article ID 1942513, 9 pages
https://doi.org/10.1155/2020/1942513

Research Article

Distribution of Number, Location of Pain and Comorbidities, and Determinants of Work Limitations among Firefighters

Goris Nazari,[1,2] Temitope A. Osifeso,[3] and Joy C. MacDermid[1,2,3,4]

MINIMAL DIFFERENCES IN SCORES

Work limitations scores	Number of painful sites			Body location		
	One painful site	Two painful sites	Three or more painful sites	Upper extremity	Lower extremity	Spine
Physical limitations	3.1 (0, 12.5)	3.1 (0, 15.6)	6.3 (0, 15.6)	3.1 (0, 15.6)	0 (0, 15.6)	6.3 (0, 12.5)
Output limitations	12.5 (6.2, 25)	12.5 (6.2, 25)	12.5 (6.2, 18.7)	12.5 (6.2, 25)	12.5 (3.1, 21.8)	12.5 (6.2, 18.7)
Time limitations	8.3 (0, 16.6)	8.3 (4.1, 16.6)	8.3 (4.1, 16.6)	12.5 (6.2, 25)	6.2 (0, 16.6)	8.3 (4.1, 16.6)
Mental limitations	15.6 (3.1, 21.8)	15.6 (6.2, 25)	15.6 (6.2, 25)	17.1 (9.3, 31.2)	12.5 (3.1, 21.8)	15.6 (6.2, 25)

Range of work limitation scores for each subscale = 0 – 100. Higher scores denote greater work limitations.

MINIMAL DIFFERENCES WITH COMORBIDITY

Table 3

Median and interquartile range (IQR) work limitation scores.

Work limitations scores	No comorbidity Median (IQR)	One comorbidity Median (IQR)	Two or more comorbidity Median (IQR)
Physical limitation scores	0 (0, 9.3)	1.6 (0, 12.5)	0 (0, 12.5)
Mental limitation scores	12.5 (3, 21.8)	15.5 (6.2, 28.1)	12.5 (0, 18.7)
Time limitation scores	4.2 (0, 16.6)	8.3 (0, 16.6)	4.2 (0, 12.5)
Output limitation scores	6.3 (0, 18.7)	12.5 (6.2, 25)	6.3 (0, 18.7)

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MINIMAL PREDICTION

Table 7

Multivariate regression results for the work limitation subscales among firefighters.

Overall	Physical (R^2 = 0.01)		Mental (R^2 = 0.06)		Output (R^2 = 0.04)		Time (R^2 = 0.02)	
	β (S.E)	ρ	β(S.E)	ρ	β (S.E)	ρ	β (S.E)	ρ
One comorbidity	-	-	4.25 (2.06)	0.04*	-	-	-	-
Two or more CM	-	-	.75 (3.20)	0.81	-	-	-	-
Age	.31 (.07)	<0.05	0.28 (.09)	0.04	0.27 (.09)	0.004	0.17 (.08)	0.04
Years of service	-	-	-.25(.10)	0.02*	-.22 (.10)	0.03 *	-	-
Constant	-4.38 (3.21)	0.12	14.76 (1.05)	<0.05	5.05 (3.77)	0.18	3.49 (3.50)	0.31

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CONCURRENT VALIDITY

Journal of Occupational Rehabilitation (2019) 29:194–204
https://doi.org/10.1007/s10926-018-9778-6

Work Functioning Among Firefighters: A Comparison Between Self-Reported Limitations and Functional Task Performance

Joy C. MacDermid[1,2] · Kenneth Tang[3] · Kathryn E. Sinden[4] · Robert D'Amico[5]

Published online: 25 May 2018

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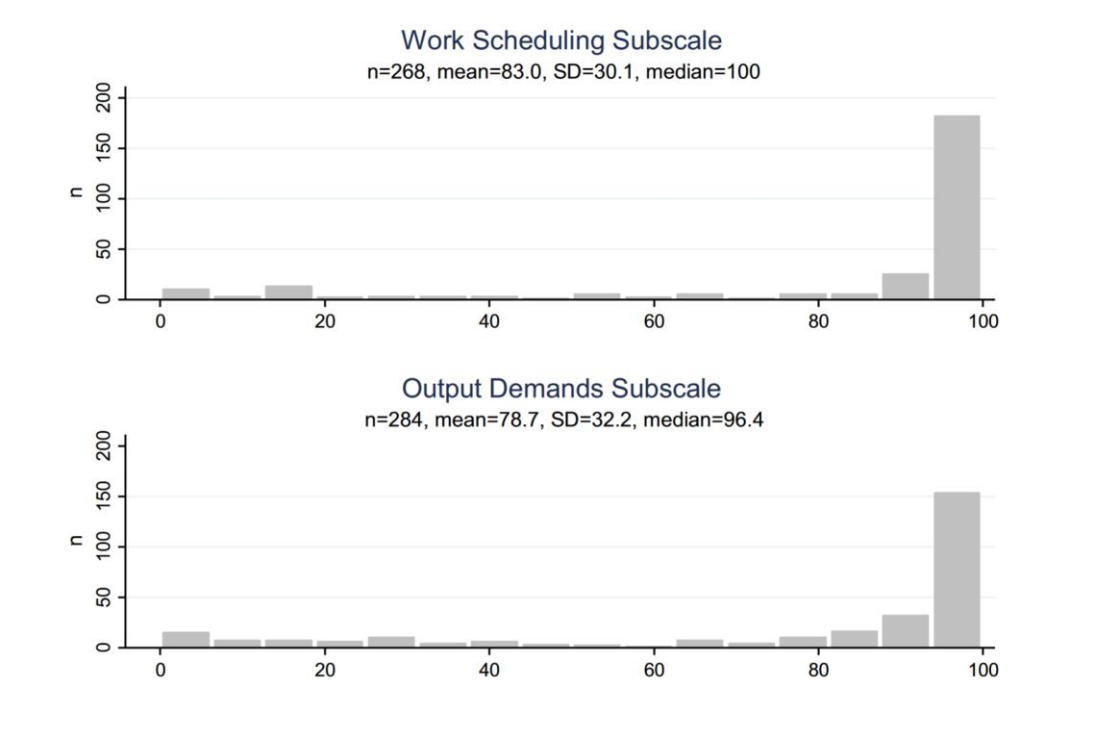
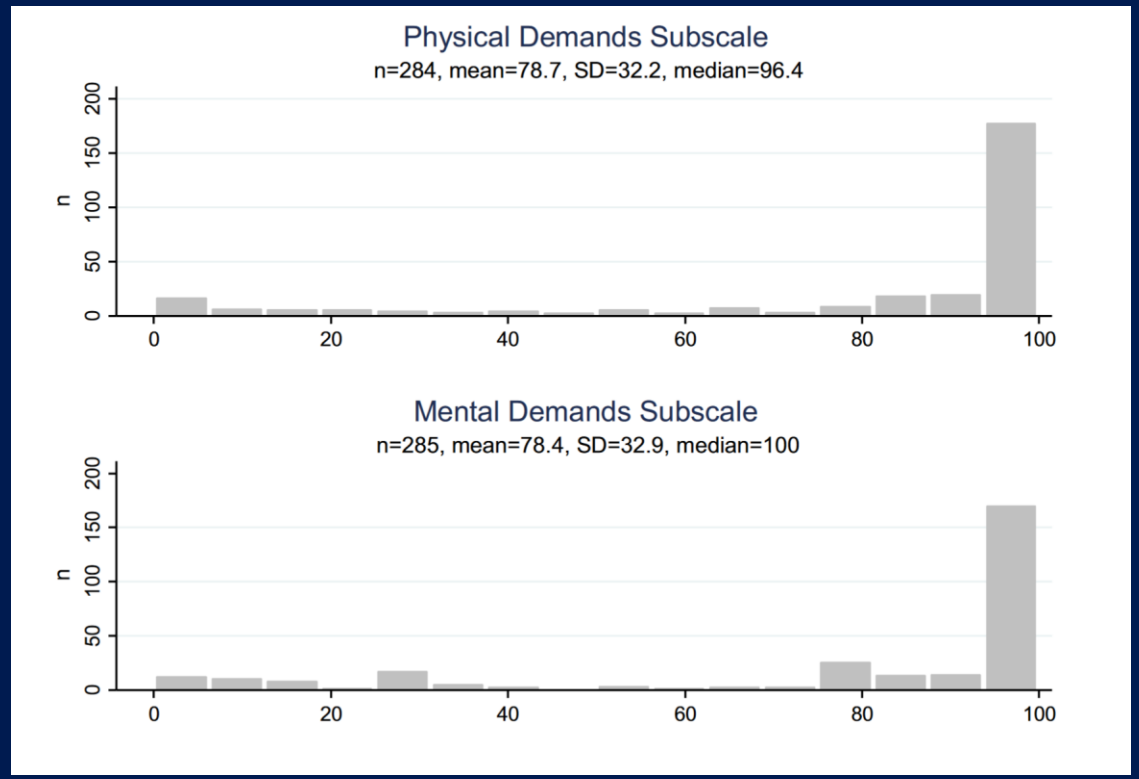
CEILING EFFECTS ON WLQ





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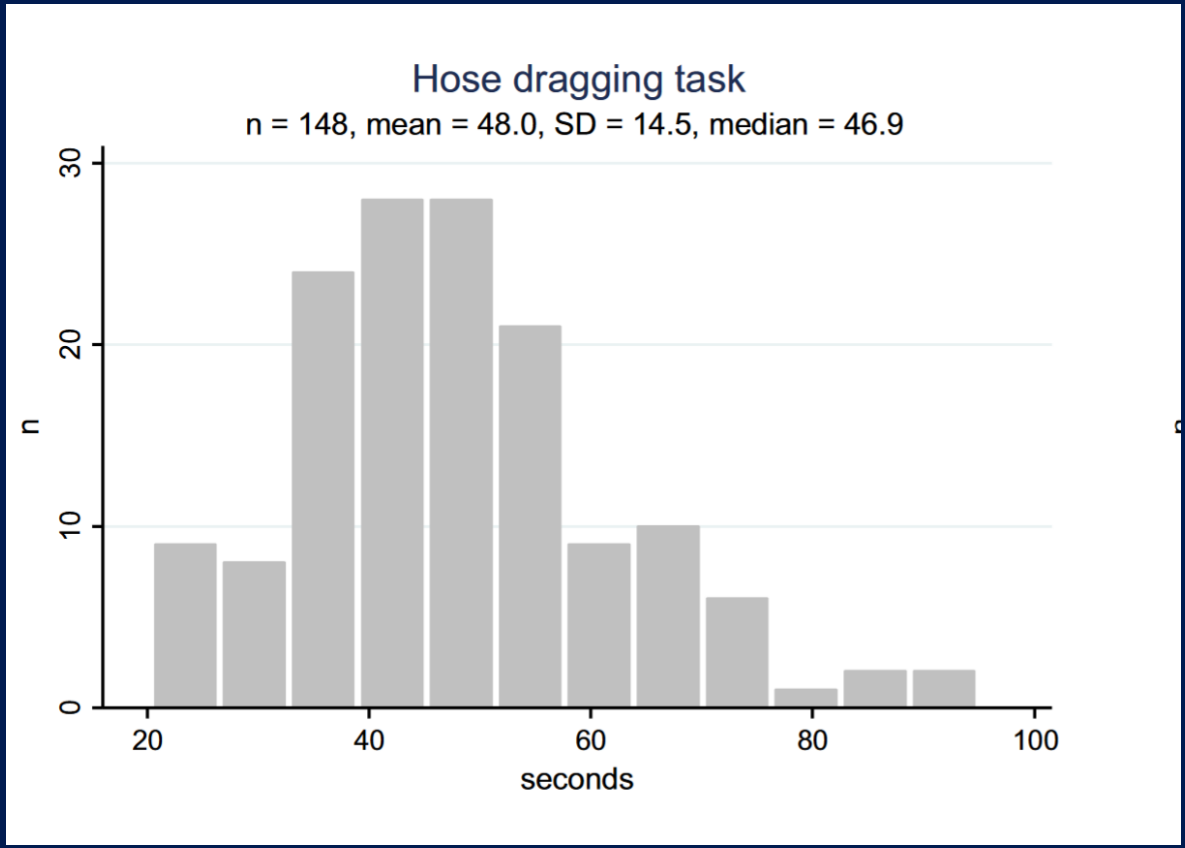
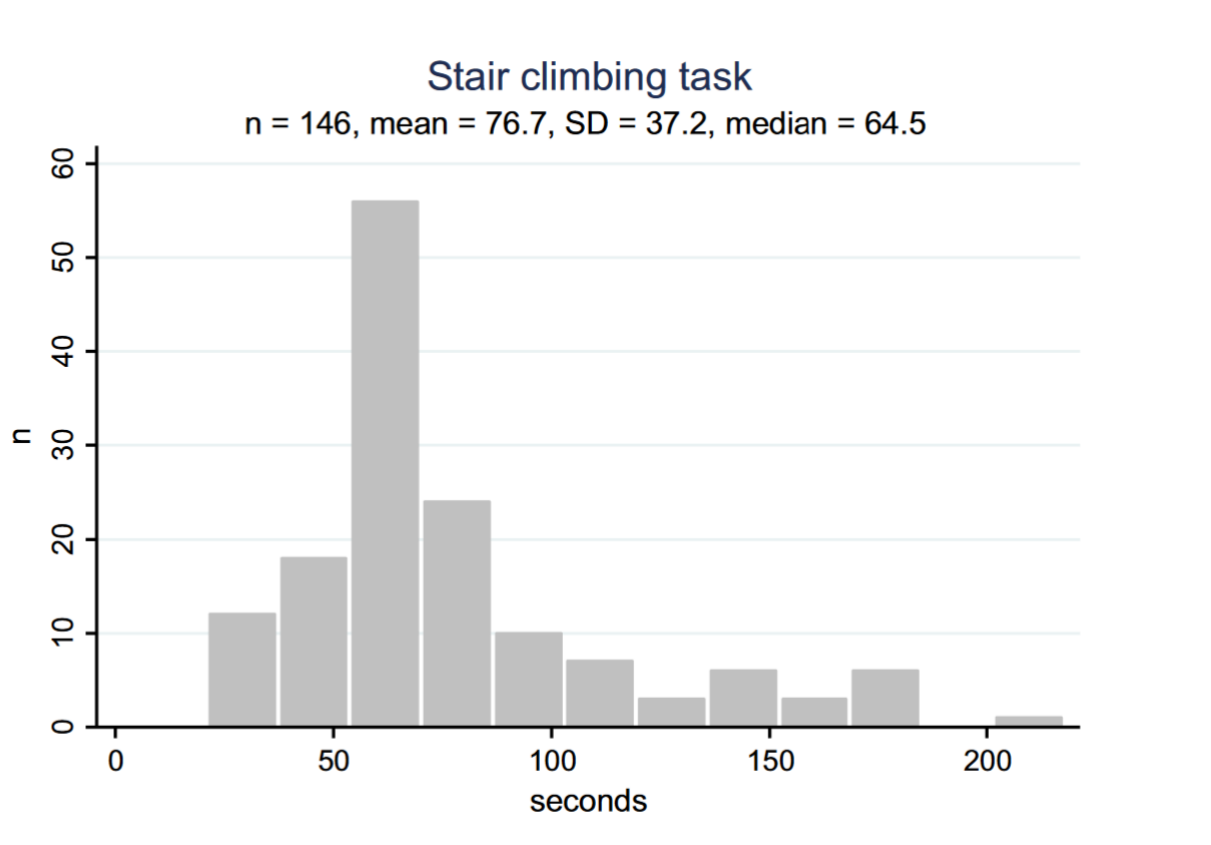
NORMAL DISTRIBUTION FOR PERFORMANCE





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AMERICAN JOURNAL OF INDUSTRIAL MEDICINE
INCORPORATING ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Research Article

The 11-item workplace organizational policies and practices questionnaire (OPP-11): examination of its construct validity, factor structure, and predictive validity in injured workers with upper-limb disorders[†‡§]

Kenneth Tang MSc(PT), MSc, Joy C. MacDermid PhD, Benjamin C. Amick III PhD, Dorcas E. Beaton PhD

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SHORT OPP ..ONLY 1 ITEM ON ERGONOMICS

J Occup Rehabil (2017) 27:258–267
DOI 10.1007/s10926-016-9653-2

CrossMark

Confirmatory Factor and Rasch Analyses Support a Revised 14-Item Version of the Organizational, Policies, and Practices (OPP) Scale

Qiyun Shi[1,2] · Joy C. MacDermid[1,2,3,4] · Kenneth Tang[3] · Kathryn E. Sinden[5] · Dave Walton[1] · Ruby Grewal[6]

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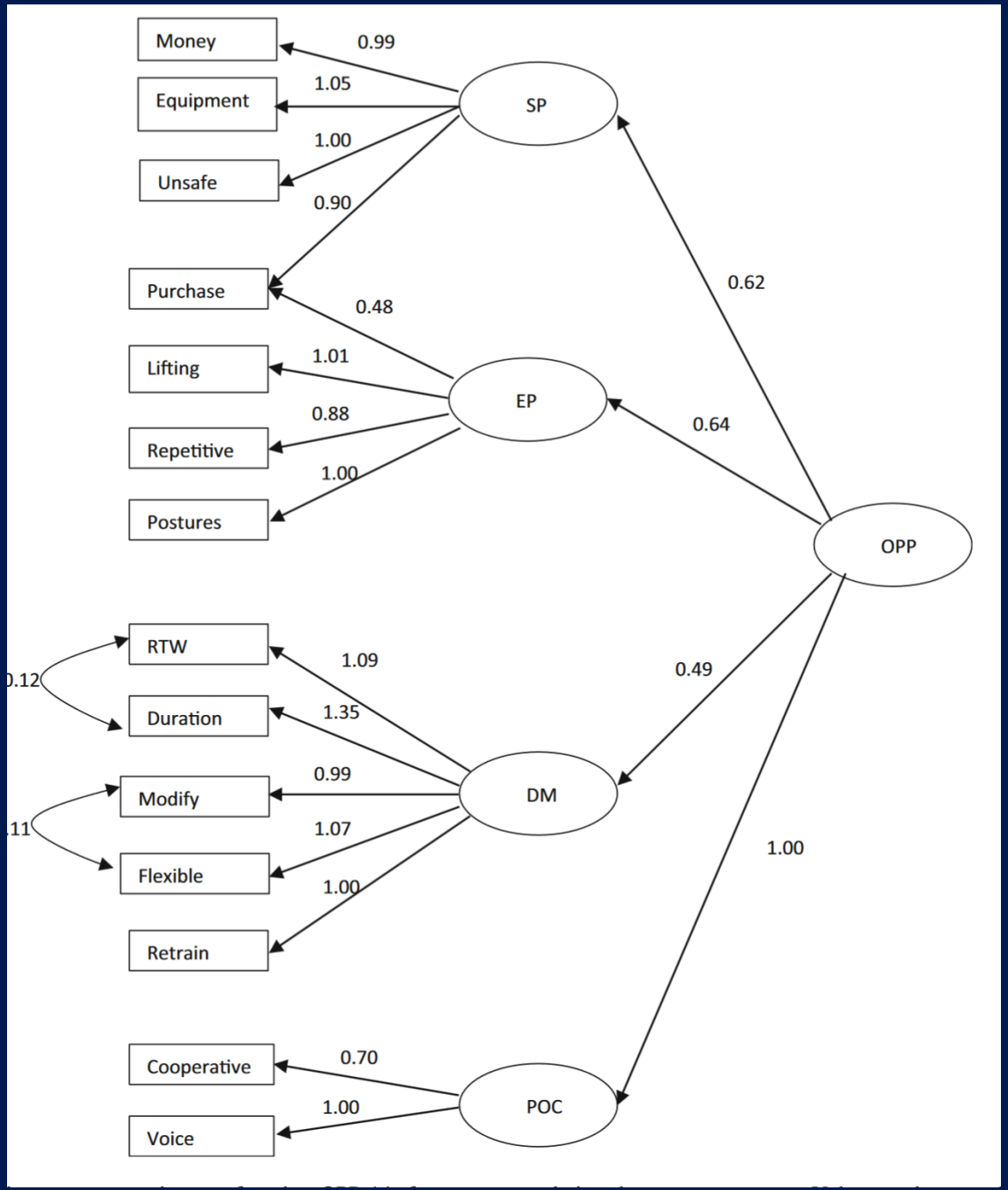
OPP-14

- The OPP-14 was developed by adding three additional items to the ergonomics subscale.
- SP- safety practices,
- EP-ergonomic practices,
- DM-disability management,
- POC-people oriented climate



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International Archives of Occupational and Environmental Health (2022) 95:723–735
https://doi.org/10.1007/s00420-021-01800-0

ORIGINAL ARTICLE

Check for updates

Identifying predictors of return to work and the duration of time off work in first responders affected with musculoskeletal injuries or mental health issues

Shannon C. Killip[1] · Joy C. MacDermid[1,2,3] · Kathryn E. Sinden[4] · Rebecca E. Gewurtz[1] · Liz Scott[5,6]

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Table 5 Predictors of the three return-to-work outcomes and the claim closure outcome based on the Cox proportional hazard models

	Hazard ratio	Standard error	*z* value	*p* value ($\alpha = 0.05$)	9
Predictors of general RTW ($n = 66$)					
MSK injuries	2.03	0.60	2.40	0.016	
Anxiety/stress mental health claims	0.45	0.17	− 2.11	0.035	
Claim lag (days)	0.98	0.008	− 1.97	0.048	
Predictors of RTW modified ($n = 39$)					
MSK injuries	6.00	3.30	3.26	0.001	
Medical report lag (days)	0.98	0.009	− 1.97	0.048	
Anxiety/stress mental health claims	0.14	0.083	− 3.26	0.001	(
Predictors of RTW full ($n = 67$)					
Claim lag (days)	0.98	0.004	− 4.95	< 0.001	
RTW full first without requiring modified work	5.21	1.73	4.98	< 0.001	
Predictors of claim closure ($n = 67$)					
RTW modified	2.73	0.99	2.77	0.006	
RTW full	2.77	1.06	2.66	0.008	

MSK INJURIES FASTER RTW THAN MENTAL INJURIES

Claim lag delayed RTW

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DEVELOPING A FIREFIGHTER SPECIFIC WORK LIMITATIONS QUESTIONNAIRE

Study Objective

- To develop a firefighter-specific work limitations questionnaire using a mixed-methods approach.

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Instrument Design

Item Generation (Qualitative)

- Twenty-one firefighters (15 males, 6 females) from across Canada (Alberta, British Columbia, Nova Scotia, Ontario, Prince Edward Island, Quebec) were interviewed using a semi-structured guide to assess areas of work limitation.
- The phone interviews were recorded and transcribed verbatim.
- Nominal group exercise was conducted with 20 firefighters at a provincial firefighter conference.
- Items generated from the firefighter interviews and nominal activities were categorized into the 5 domains.

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Methods

Item Selection (Quantitative)

- Fifty-three firefighters completed a content analysis survey evaluating the relevance of the items and the frequency with which they were performed.
- From this analysis, items were classified as:
  - strong potential
  - questionable
  - not appropriate
- The strong and questionable items were further reduced and clarified by a panel of expert measurement experts working with firefighters.

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Results: Themes = Subscales

- Descriptive content analysis identified 5 themes:

1. **Physical Demands**
2. **Social Demands**
3. **Cognitive Demands**
4. **Emotional Demands**
5. **Routines and Time Management**

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PHYSICAL DEMANDS (ITEMS 1-12)

Date: ____/____/_____ ID Code: _____
dd / mm / yyyy

Firefighter Work Limitations Questionnaire (FF-WLQ-36)

Think about your recent performance of the firefighting tasks listed below. Rate how much you were limited in your ability to do your usual firefighting tasks.
Check "Does Not Apply" if the question asks about something that is not part of your job.

How much were you **limited?**	**Not Limited at all (0%)**	Limited some (25%)	**Limited to half (50%)**	Limited a lot (75%)	**Unable to do (100% limited)**	Does Not Apply
1. Put on and wear PPE	☐	☐	☐	☐	☐	☐
2. Put on and wear SCBA	☐	☐	☐	☐	☐	☐
3. Perform CPR	☐	☐	☐	☐	☐	☐
4. Lift/carry heavy tools	☐	☐	☐	☐	☐	☐
5. Enter/exit fire truck and load/unload equipment	☐	☐	☐	☐	☐	☐
6. Fire suppression tasks	☐	☐	☐	☐	☐	☐
7. Use axes, nozzles, ropes, door breaching equipment, extrication tools, chainsaws, and other firefighting equipment	☐	☐	☐	☐	☐	☐

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. OUTPUT DEMANDS (ITEMS 13-18)

13. Able to manage full shift/call	☐	☐	☐	☐	☐	☐
14. Complete all drills or training	☐	☐	☐	☐	☐	☐
15. Maintain firehouse/ department routines (e.g., truck and equipment checks, general maintenance)	☐	☐	☐	☐	☐	☐
16. Keep up the pace for urgent tasks	☐	☐	☐	☐	☐	☐
17. Maintain expected speed and proficiency	☐	☐	☐	☐	☐	☐
18. Complete tasks at the level needed to protect public safety	☐	☐	☐	☐	☐	☐

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INTERPERSONAL DEMANDS (19-23)

How much were you **limited?**	**Not Limited at all (0%)**	Limited some (25%)	**Limited to half (50%)**	Limited a lot (75%)	**Unable to do (100% limited)**	Does Not Apply
24. Manage my emotions during critical incidents	☐	☐	☐	☐	☐	☐
25. Manage my emotions after a bad call	☐	☐	☐	☐	☐	☐
26. Keep out distracting memories/emotions	☐	☐	☐	☐	☐	☐
27. Avoid compassion fatigue and burnout	☐	☐	☐	☐	☐	☐
28. Manage emotions related to calls involving children	☐	☐	☐	☐	☐	☐
29. Manage stress response from alarms/ emergency calls	☐	☐	☐	☐	☐	☐

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EMOTIONAL DEMANDS (ITEMS 24-29)

24. Manage my emotions during critical incidents	☐	☐	☐	☐	☐
25. Manage my emotions after a bad call	☐	☐	☐	☐	☐
26. Keep out distracting memories/emotions	☐	☐	☐	☐	☐
27. Avoid compassion fatigue and burnout	☐	☐	☐	☐	☐
28. Manage emotions related to calls involving children	☐	☐	☐	☐	☐
29. Manage stress response from alarms/ emergency calls	☐	☐	☐	☐	☐

COGNITIVE DEMANDS (ITEMS 30-36)

30. Remember specific training (e.g., equipment), protocols, operating procedures	☐	☐	☐	☐	☐
31. Analyze personal risks on scene; situational awareness	☐	☐	☐	☐	☐
32. Make critical decisions	☐	☐	☐	☐	☐
33. Transition from one task to another quickly	☐	☐	☐	☐	☐
34. Prioritize actions	☐	☐	☐	☐	☐
35. Focus on tasks at hand	☐	☐	☐	☐	☐
36. Problem-solve in stressful situations	☒	☐	☐	☐	☐

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Discussion

- The value of a self-reported tool MAY be useful for
  - early identification of work limitations
  - Testing readiness to RTW
  - Evaluating treatment/wellness programs

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NEXT STEPS

- Psychometric Evaluations
- Use in interventional Studies
  - Peer Support Apps and Training
  - Resiliency Training
  - MSK shoulder training program
- Use in
  - Disease Monitoring (cancer, MSK, OSI)
  - Accommodation

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SUMMARY

- Measuring Firefighter health outcomes is complicated because

- Impairments may not predict work performance
- Extra healthy worker effect
- Sex differences
- Simulated Fire Tasks Time intensive and lack contextual pressures
- Real world assessments difficult due to equipment, heat exposures time pressures
- Self-report may under estimate effort (macho culture?)

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IMPLICATIONS

Need for fire specific assessments that are validated against real world performance and health outcome

Potential to apply emerging technologies

Multi-modal assessments need to support insightful interpretation

Self report and performance based assessments both important

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