

CONTENTS

<i>ACKNOWLEDGMENTS</i>	ix	3.4 Functional Spinal Unit	31
<hr/>		3.5 Spine Support	32
CHAPTER 1 INTRODUCTION	1	3.6 Ligaments	32
<hr/>		3.7 Muscles	35
1.1 Audience for the Book	3	3.8 Fascia	35
1.2 Apolitical Causality Assessment	4	3.9 Nerves	37
1.3 A Systems View of Low Back Pain Causality	4	3.10 Blood Vessels	39
1.4 The Reality of Work	5	3.11 End Plates and Nutrition	40
1.5 How Might the Different Aspects of Work Be Associated with Back Pain	6	3.12 Facets	40
1.6 Organization of the Book	8	3.13 The System	41
		Key Points	41
CHAPTER 2 BACK PAIN MAGNITUDE AND POTENTIAL RISK FACTORS	11	<hr/>	
<hr/>		CHAPTER 4 THE PROCESS OF PAIN	43
2.1 What is Back Pain?	11	<hr/>	
2.2 How Common is Back Pain?	11	4.1 What is Pain?	43
2.3 Back Pain at Work	12	4.2 Origins of Pain	44
2.4 Epidemiology of Work Risk Factors	13	4.3 Pain Transmission	44
2.5 Epidemiology of Physical Risk Factors	16	4.4 The Pain Process	46
2.6 Epidemiology of Individual (Personal) Risk Factors	18	4.5 The Inflammatory Process (Cytokines)	48
2.6.1 Age	18	4.6 Peripheral Nervous System Sensitization	50
2.6.2 Gender	18	4.7 Neuropathic Pain: The Cytokine Cascade and Nerve Sensitization	51
2.6.3 Anthropometry	19	4.8 Pain Mechanisms of the Central Nervous System	51
2.6.4 Fitness/Strength	20	4.9 Role of the Environment in Central Sensitization	52
2.6.5 Alcohol	20	4.10 Implications for Low Back Pain	53
2.6.6 Smoking	21	4.11 Nerves at Risk of Sensitization	53
2.6.7 Heredity/Genetics	21	4.12 Tissues at Risk of Sensitization	53
2.6.8 Social Class and Psychological Factors	21	4.13 Disk and Nerve Roots	54
2.7 Epidemiology of Work-Related Psychosocial/Organizational Factors	22	4.14 Facet Joints	54
2.8 Potential Interaction of Physical and Psychosocial Factors	23	4.15 Muscular-Based Pain	55
Key Points	25	4.16 Lumbar Nerve Roots	56
		4.17 Relationship between Tissue Loading and Pain	56
CHAPTER 3 FUNCTION, STRUCTURE, AND SUPPORT OF THE BACK	29	4.18 Conclusions	56
<hr/>		Key Points	56
3.1 Body Coordinates	29	<hr/>	
3.2 Bony Structures of the Spine	29	CHAPTER 5 POTENTIAL PATHWAYS TO BACK PAIN	60
3.3 The Disc (and the Spinal Joint)	31	<hr/>	
		5.1 Views of Back Pain Causality	60

5.2	A Unifying Model of Low Back Pain Pathways	63	7.3	Strength Capacity Assessments of Work Load	119
5.3	The Support Structure Disruption Pathways	65	7.3.1	Static Analyses of Work Load	120
5.3.1	Support Structure Tolerance	66	7.4	Dynamic Analyses of Work Load	121
5.4	Disc Tolerance Summary	73	7.5	Surveillance Conclusions	127
5.5	Pain Tolerance	74	7.6	Spine Loading and Task Performance	127
5.6	The Muscle Function Disruption Pathway	74	7.7	Spine Loading and Primary Physical Workplace Factors	128
5.7	The Role of Individual Differences in the Pain Pathways	79	7.7.1	Moment Exposure	128
5.8	System Feedback	81	7.8	Role of Trunk Muscle Cocontraction in Spine Loading	129
5.9	Summary	81	7.9	Trunk Motion	130
	Key Points	82	7.10	Nonsagittal Plane Loading	133
			7.10.1	Lateral Motion	134
			7.10.2	Twisting Motion	136
			7.10.3	Task Asymmetry	138
			7.10.4	Lift Height	139
			7.10.5	One-Handed Versus Two-Handed Lifting	142
			7.11	Lifting Versus Lowering	146
			7.11.1	Cumulative Exposure	147
			7.12	Duration of Exposure to Lifting Tasks	148
			7.13	Worker Experience, Task Frequency, and Moment Exposure	150
			7.14	Spine Loading Associated with Modification of Physical Workplace Factors	154
			7.14.1	Handles	154
			7.15	Lifting While Supporting the Body	156
			7.16	Team Lifting	158
			7.17	Pushing and Pulling	160
			7.18	Seated and Constrained Work Postures	164
			7.19	Physical Work Factor Summary	166
			7.20	Summary	169
				Key Points	170
CHAPTER 6 THE ASSESSMENT OF BIOMECHANICAL FORCES ACTING ON THE LOW BACK			CHAPTER 8 PSYCHOSOCIAL AND ORGANIZATIONAL FACTOR INFLUENCE ON SPINE LOADING		
		87			174
6.1	Biomechanical Concepts Applicable to the Back	88	8.1	Introduction	174
6.1.1	Load Tolerance	88	8.2	Psychosocial and Organizational Interactions	175
6.1.2	Moments and Levers	89	8.3	Biomechanical Responses to Psychosocial Environment	176
6.1.3	External Versus Internal Loading	90	8.4	Biomechanical Responses to Mental Stress at Work	178
6.2	How can we Modify Internal Spine Loads?	92	8.5	Expectation	182
6.2.1	Biomechanical Arrangement of the Musculoskeletal Lever System	92	8.6	Conclusions	183
6.2.2	Length–Strength Relationship	92		Key Points	183
6.2.3	The Impact of Velocity on Muscle Force	93			
6.2.4	Temporal Relationships	94			
6.3	Incorporating Spine Load Reductions into the Work System	95			
6.4	Loading of the Lumbar Spine	95			
6.5	Spine Load Assessments	96			
6.6	Models of Spine Load	97			
6.7	Biologically Driven Modeling of Spine Loading	100			
6.8	Stability-Driven Spine Loading Models	106			
6.8.1	Predictions of Muscle (Motor) Control within Torso	108			
6.9	What Drives Motor Control? The Mental Model	110			
6.10	Summary	112			
	Key Points	112			
CHAPTER 7 THE INFLUENCE OF PHYSICAL WORK FACTORS ON MUSCLE ACTIVITIES AND SPINE LOADS					
		117			
7.1	Introduction	117			
7.2	Industrial Quantitative Surveillance of Physical Exposure	118			

**CHAPTER 9 INDIVIDUAL FACTORS ROLE
IN SPINE LOADING 187**

- 9.1 Introduction 187
- 9.2 Gender 187
 - 9.2.1 Personality 193
- 9.3 Experience 196
- 9.4 Conclusions 198
- Key Points 198

**CHAPTER 10 PHYSICAL, INDIVIDUAL, AND
PSYCHOSOCIAL/ORGANIZATIONAL RISK
FACTOR INTERACTIONS 200**

- 10.1 When Risk Factors Collide 200
- 10.2 The Magnitude of Influence
of the Three Risk Factor Categories 201
- 10.3 Can Risk Factor Interactions be
Predicted? 206
- 10.4 Conclusions 207
- Key Points 208

**CHAPTER 11 ENGINEERING CONTROLS TO
MEDIATE BACK PAIN AT WORK: TOOLS
FOR THE ASSESSMENT OF PHYSICAL
FACTOR IMPACT ON SPINE LOADS
AND INTERVENTION EFFECTIVENESS 210**

- 11.1 Introduction 210
- 11.2 Static Strength Prediction Programs 211
- 11.3 Psychophysical Tolerance Limits 212
- 11.4 Job Demand Index 214
- 11.5 NIOSH Lifting Guide and Revised
Equation 214
 - 11.5.1 The 1981 Lifting Guide 214
 - 11.5.2 The 1993 Revised Equation 216
- 11.6 Video-Based Biomechanical
Models 218
- 11.7 Lumbar Motion Monitor Risk
Assessment 219
- 11.8 Lifting Threshold Limit
Values (TLVs) 222
- 11.9 Workplace Assessment
Comparisons 226
- 11.10 Conclusions 229
- Key Points 229

**CHAPTER 12 ADMINISTRATIVE CONTROLS
FOR THE WORKPLACE: PSYCHOSOCIAL
AND ORGANIZATIONAL INTERVENTIONS 232**

- 12.1 Implementing Psychosocial
and Organizational Change 232
- 12.2 Elements of the Process 234

- 12.3 Traditional Administrative Controls 236
 - 12.3.1 Worker Selection 236
 - 12.3.2 Worker Rotation 236
 - 12.3.3 Training 237
 - 12.3.4 Stretching Programs 237
 - 12.3.5 Back Belts 238
- 12.4 Summary 239
- Key Points 240

**CHAPTER 13 INTEGRATING RISK
INTERVENTIONS INTO THE WORKPLACE 242**

- 13.1 Introduction 242
- 13.2 Systems Intervention 242
- 13.3 Examples of Intervention
Effectiveness 243
 - 13.3.1 Patient Handling Interventions 243
 - 13.3.2 Types of Physical
Interventions 246
- 13.4 Implementing Both Physical
and Psychosocial Interventions 247
 - 13.4.1 Distribution Center
Interventions 248
- 13.5 Summary 248
- Key Points 249

**CHAPTER 14 UNDERSTANDING RECURRENT
LOW BACK PAIN AND IMPLICATIONS
FOR RETURN TO WORK 251**

- 14.1 Introduction 251
- 14.2 The Natural History of Low Back
Pain Recovery 252
- 14.3 How can One Quantify the Extent of
Low Back Pain? 253
 - 14.3.1 Impairment Assessment 254
 - 14.3.2 Effort Sincerity 267
- 14.4 Spine Loading of those Experiencing
Low Back Pain 272
- 14.5 Can Kinematic Impairment
Assessments Predict Changes
in Spine Loading? 281
- 14.6 Lifting Exposure Limits for Workers
with LBP 285
- 14.7 Recurrence of LBP and Work 286
- 14.8 A Return-to-Work Strategy 292
- 14.9 Conclusions 292
- Key Points 293

CHAPTER 15 CONCLUSIONS 298

- 15.1 Summary 301

INDEX 303
