UNIVERSITY OF CALIFORNA

Los Angeles

Workplace Intervention to Reduce Back Pain Through the Control of Early Morning Flexion

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy

in Environmental Health Sciences

by

George Erich Brogmus

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ABSTRACT OF THE DISSERTATION

Workplace Intervention to Reduce Back Pain Through the Control of Early Morning Flexion

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University of California, Los Angeles, 2021

Professor Wendie Robbins, Chair

The goal of this research was to test the hypothesis that a brief workplace training session on control of early morning flexion (bending – and other spine-loading activities) can significantly reduce back pain incidence, claims, disability and the associated costs. Back pain is the leading cost driver for workers' compensation claims, globally the leading cause of days lived with disability, and one of the leading reasons people seek medical care outside of workers' compensation. Diagnostic methods, including imaging, have not proven to result in improved outcomes. Treatments by health care professionals, regardless of specialty, have been shown to be equally effective, and comparable to education-only results. In this context, self-care approaches have garnered attention. One such approach that has shown promise for chronic low back pain sufferers is the control of early morning flexion. The current study tested this intervention in a workplace setting through a training session to control spine-loading activities within the first two hours of rising from sleep in a prospective cluster-randomized partial cross-over controlled intervention. 157 of 290 eligible university custodial services workers' completed a baseline questionnaire and were randomly assigned (by supervisor group) into treatment and sham groups then given either treatment (bending) or sham training (lifting technique training known to have no significant impact on back pain). The questionnaire contained demographic, back pain history, workplace, activity, and exercise questions. After one year, the questionnaire was completed again and all subjects were then given the treatment training. After one more year, the questionnaire was completed again. Analysis of the baseline data revealed that when time between rising from sleep and leaving for work were less than two hours, LBP risk increased by 119%, and sciatica risk increased 152%. Bending, sitting, and lifting (objects over 10 pounds) during the first two hours after rising performed "Nearly All the Time" were associated with a 47-fold increased risk of very severe pain and 39 more days with LBP within a 6-month period. Moderate exercise after waking appeared to be somewhat protective. Mixed effects analyses with corresponding predicted values were used to assess the impact of the intervention prospectively. A pattern of greater reduction in odds and incident rate ratios for most back pain measures was observed for the treatment training as well as for the treatment. The greatest decreases for treatment training were for total days of back pain (50% reduction of incident rate ratio) and medication use for back pain (47% reduced odds). Workers should limit spine-loading activities within the first two hours after waking, although exercise may be helpful. Employers should avoid scheduling spine-loading tasks such as sitting, bending, or lifting at the beginning of work shifts. Clinicians may recommend to limit spine-loading activities within two hours after waking from sleep both at home and at work.

The dissertation of George Erich Brogmus is approved.

Niklas Krause

Fadi Fathallah

Jian Li

Wendie Robbins, Committee Chair

University of California, Los Angeles

2021

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4 ACKNOWLEDGEMENTS

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My deepest appreciation is expressed to my committee members, past and present. Dr. Krause has served on my committee from February, 2011, and as my committee chair from May, 2012 till his retirement in September, 2021, and again as a committee member from September, 2021 through December, 2021. Dr. Krause patiently provided me with ongoing advice and guidance through my entire research project. I am honored that he is one of my coauthors on the cross-sectional and prospective papers being prepared for publication from the results of this dissertation. I will always be indebted to his generous gift of his time and insight. I do hope the future allows me to return at least a small portion of his support by supporting him in some way. Dr. Krause, "Thank you" seems too little to say, nonetheless, thank you.

I could not have made it through the UCLA Institutional Review Board process and forms without the kind assistance of Dr. Robbins. Dr. Robbins has served on my committee since May, 2012 and was kind enough to be the final Chair of my committee starting in September, 2021 – thank you Dr. Robbins. Thanks, are also due to Dr. Nola Kennedy, who was my first Doctoral Committee Chair starting in February, 2011 through her departure from UCLA in May, 2012 and helped me choose appropriate coursework and initiate my research. I'm also grateful for Dr. Kennedy being one of the coauthors on the cross-sectional and prospective papers being prepared for publication from the results of this dissertation.

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UCLA's Ergonomists, Cynthia M. Burt and Benjamin P. Doyle, did the heavy lifting of recruiting subjects, which included multiple meetings (informational and consent) as well as being trained in and delivering the many treatment training sessions needed to complete this research. Ms. Burt and Mr. Doyle are also coauthors on the cross-sectional and prospective papers being prepared for publication from the results of this dissertation. My gratitude and debt to Ms. Burt and Mr. Doyle is deep.

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I owe special thanks to Rebecca Greenberg. Without Rebecca's essential help navigating administrative details, I may have despaired to the point of retirement. Rebecca was a constant source of encouragement and practical help.

I only recently had the honor to co-author a paper with Dr. Stover Snook, but for the past 4 decades he has been my ideal of a researcher and gentleman. It was his seminal research project on back pain reduction through control of early morning flexion that set me on the path of this current research. I am indebted to him for his example and his many years of mentoring me. Thank you, Dr. Snook!

I have a lifetime of gratitude to my mother, Libby Brogmus, who was an inspiration to me. She set the standard in my life for hard work and continually pursuing more knowledge and education. She broke through barriers and persevered – qualities I admire and have striven to possess. Thank you, Mom, for your support, not only financially so I could complete this dissertation, but for your constant encouragement and the confidence in me that I could complete this work. And thanks to my late dad, who by his example and love always helped me stay focused on the good things in life.

There are those who inspire and encourage and then there are those who you are so grateful for that you dedicate your entire being to their well-being. My wife, Iberia Brogmus, is such a person. Without question, I would not have completed this work without her encouragement. When first contemplating a doctoral program, she asked, "What else are you going to do with your time?" Of course, I thought it would be a few years, not a decade plus, but that was the nudge I needed to get started. Her love, support, and encouragement carried me through all the tough times. Thank you, Iberia. I love you. Now it's your turn…

To my children, you were the observers that I could not disappoint by quitting, so you inspired me to keep at it. Sierra and Raquel, you were the extra-curricular blessings that may have slightly extended the time it took me to finish, but without you and your mom I would have little reason for continuing anything. You continue to bring joy and gladness and pride into my life. I love you and thank you both with all my heart.

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This research would not have been possible without the support of UCLA's Custodial Services (a division of the Campus Maintenance Department). They not only provided access to their staff but provided work time for their training and questionnaire completion. Most of all, thanks are due to the custodians who completed the questionnaires.

5 ABREVIATED CURRICULUM VITA

George Erich Brogmus

EXPERIENCE

Product Director – Science & Research, 8/31/2020 to 7/31/2021. Liberty Mutual Insurance Company, Risk Control Services. Responsible for harvesting and commissioning science and research relevant to the business interests of Liberty Mutual's Risk Controls Services department. Notable accomplishments:

- Launched the Liberty Mutual/Kinetica iPhone App, ErgoValuator July 2020.
- Continued oversight of the Liberty Mutual Workplace Index.
- Appointed Industry Advisory Board Chair for the Industry-University Cooperative Research consortium, Center for Disruptive Musculoskeletal Innovations (CDMI).
- Voting Member of ASTM F48 Exoskeleton Committee

Technical Director – Science & Technology, 1/2018 to 8/31/2020. Liberty Mutual Insurance Company, Risk Control Services. Directly responsible for managing all activities necessary to identify, develop, and spread knowledge on scientific and emerging technology trends within occupational safety and health. Noteworthy accomplishments have included:

- Creator of the Liberty Mutual Annual Innovation Award (1st award 2020) to promote development of specific technological advancements needed in the field of safety.
- Commissioned multiple projects including sponsorship of UCSF, University of Michigan, and Harvard University projects.

Technical Director-Ergonomics, 9/1996 to 12/2017. Liberty Mutual Insurance Company. Responsible for quality of risk management and ergonomic services and development of field service tools for application of ergonomic principles countrywide. Noteworthy projects have included creation and development of:

- Regression of data on the NIOSH Revised Lifting Equation into a back-injury risk prediction equation based on the best published field validation research.
- A risk estimation model based on work scheduling parameters – the Liberty Mutual Work Scheduling Injury Risk Estimator™ (SIRE™).
- A demographic analysis tool for aging worker trends
- Assisted with foundational research and product development of a video-based lifting technique biomechanical analysis system (VidLiTeC™)

Project Director, Engineering Solutions (a division of the Liberty Mutual Research Institute for Safety, formerly called the Liberty Mutual Research Center for Safety and Health), 1995 to 8/96. Responsible for product development, project contract negotiation, and implementation.

Senior Research Associate, 3/93 to 8/96. Liberty Mutual Research Center for Safety and Health.

Technical Consultant, 8/82 to 2/93. Liberty Mutual Insurance Company. Responsibilities included analysis of client company operations and products to provide clients with recommendations for improving materials handling, production flow, workstation design, and risk reduction.

TEACHING

Part-Time Instructor, ***California State University Northridge***. Instructor for the graduate course offered every Fall Semester, Occupational Ergonomics, 2014 to present.

Teaching Associate, ***UCLA***. Instructor for the graduate course offered every spring, Occupational Safety and Ergonomics, Monthly Webinar Series on Ergonomics. 2008 to present.

Guest Lecturer, ***Harvard School of Public Health***. Lectured on cumulative trauma disorders of the upper extremities and macroergonomics for the Ergonomics short course. Multiple years.

Guest Lecturer, ***University of Connecticut***. ***University of Southern California***. ***Arizona State University***. Lectured on ergonomics research, ergonomics consulting, the systems approach to ergonomic interventions and careers in ergonomics.

EDUCATION

Ph.D. Candidate in Ergonomics (Specializing in Back Pain reduction), UCLA, School of Public Health, Environmental Health Sciences Department, May 4, 2012.

Master of Science in Human Factors - Human Performance and Aging option, University of Southern California. Graduated Phi Kapa Phi, May, 1991.

Bachelor of Science, Electrical Engineering, University of California, Los Angeles, 4/78 to 6/82.

AWARDS, HONORS, AND SERVICE

HRSA Fellowship Grant, March, 2011. U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA) Fellowship grant. Support for academic pursuit of workplace interventions that help protect minorities from workplace hazards.

Co-inventor of the Liberty Mutual Musculoskeletal Stress Measurement System, Patent Number 5,467,656, granted November, 21, 1995, a system for measurement of torques, forces, repetitiveness and awkward postures associated with manual materials handling and repetitive motion tasks.

PUBLICATIONS

Lead or co-author on over 40 publications in the fields of occupational ergonomics and safety/risk.

6 INTRODUCTION

6.1 STATEMENT OF THE PROBLEM

Back pain is one of the most common reasons for seeing a doctor[1], is globally responsible for more days lived with disability than any other condition[2,3], and is responsible for up to one-third of all workers' compensation costs[4]. The lifetime prevalence of low back pain (LBP) has been estimated as high as 84%[5]. Group or personal health insurance costs are likewise adversely impacted, as are indirect costs such as lost productivity, absenteeism, training replacement workers and loss of quality of life, bringing total cost estimates[6] in the US up to $600 billion. Despite the cost and adverse impact to society, research has not revealed a clear pathoanatomical etiology and consequently up to 85% of back pain is best described as idiopathic[7]. Research over the past 20 years suggests that much back pain may be due to inflammatory responses that activate pain receptors in innervated portions of the intervertebral discs and nerve roots of the spinal column[8-10]. Fluids inside the disc may be responsible for this inflammatory response and can reach the nerves through annular fissures or microtears. In addition, a mechanism that may contribute to the chronicity of back pain is the fluid flow into the disc during sleep and the consequent increased bending stress on the disc upon getting up from sleep[11]. In a clinical study of chronic back pain sufferers, reduced back pain was achieved through teaching subjects to reduce their early morning stress on their backs, specifically control of early morning flexion[12,13]. This intervention has not been attempted as a preventative measure, nor has it been tried as a workplace intervention.

The current research project was conducted in a work setting and tested a training treatment to control flexion (and other spine-loading activities) after waking from sleep, to see its effect on prevention of back pain and reduction of back pain outcomes. Cross-sectional analysis results of the baseline data is presented in section 8.1 of this dissertation and results for the prospective analysis of the intervention effectiveness on back pain outcomes is presented in section 8.2 of this dissertation. A supplemental analysis of the impact of the intervention on time between leaving for or arriving at work, activity levels within two hours after waking, and exercise within two hours of waking are discussed in section 18 and a corresponding discussion in section 9.3 of this dissertation.

6.2 THE MEDICAL CAUSE OF BACK PAIN

6.2.1 Causes Unproven – Mostly Idiopathic and Not Serious

No one knows for sure what causes back pain. It has been said[14] that "almost all lumbar structures are possible sources of pain." Past theories on what causes back pain have been proven to be largely false. It was once thought that muscle spasms were responsible for much back pain, but studies[15,16] to demonstrate this revealed that this is not likely the case. Despite its prevalence in diagnosis (70%[17]), sprain or strain as a cause has not been proven[15,17,18]. Depending on age and definition, up to 70% of people without back pain (asymptomatic) have herniated discs, giving strong evidence that the presence of a herniated disc means precisely and only that – that they have a herniated disc[17-26]. Chou, et al.[20], representing the American College of Physicians, have stated that diagnostic imaging is only indicated if "severe progressive neurologic deficits" are present "that suggest a serious or specific underlying condition." They [20] go on to say, "evidence indicates that routine imaging is not associated with clinically meaningful benefits but can lead to harms…more testing does not equate to better care." Waddell[7] states that most back pain is idiopathic (non-specific) with no clear pathoanatomical cause. Waddell[7] further explains that less than 1% of back pain presented to a physician is due to a serious spinal disease such as a tumor or infection, less than 1% due to an inflammatory disease that needs rheumatologic investigation and "less than 5% is true nerve root pain, and only a small proportion of that ever needs surgery." Deyo and Weinstein[17] also document that less than 1% of presenting back pain is due to traumatic injury such as a fracture. This leaves over 90% of presented back pain as idiopathic[25]. The Occupational Medicine Practice Guidelines[22] of the American College of Occupational and Environmental Medicine (ACOEM) goes even further and states, "More than 95% of patients have no identifiable cause for their LBP [low back pain]."

In addition, these data also suggest that the vast majority of back pain, in addition to being difficult to determine a pathoanatomical cause, do not represent a serious medical issue. In a study[27] of 1,172 acute low back pain patients in Sydney, Australia, only 11 had serious pathology, despite the fact that 80% had at least one red flag at initial consultation. All 1,172 patients were followed for one year to ensure proper classification. This study also raised the issue of the low value of red flags in general – a sentiment that has been reinforced recently by Cook and associates[28] who found that, "reg flag symptoms neither rule out nor identify serious pathology".

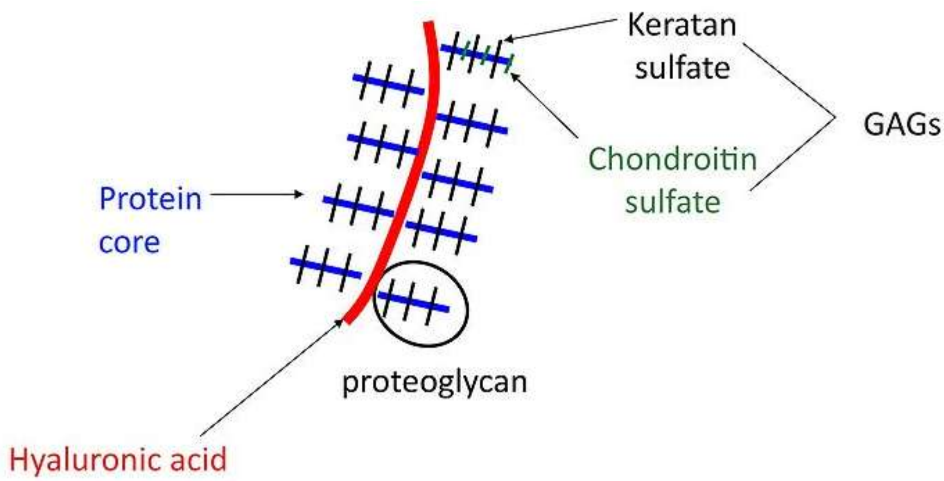

Figure 6-1. Proteoglycan structure - large, "bristly" biopolymers (protein base, covalently bonded glycosaminoglycan chains). (Creative commons license, Wikimedia.[29])

While there are many anatomical structures that could be responsible for back pain, some may be due to inflammatory responses that activate pain receptors in innervated portions of the intervertebral discs or nerve roots of the spinal column.[8-10] Proteoglycans (Figure 6-1) are large molecules that are highly hydrophilic and abundant in the nucleus of the intervertebral disc. They are responsible for the gel-like structure of the nucleus, and help to hydraulically distribute stress across the disc, while allowing for mobility of the spine. They also play a role in inhibiting vascular and neuronal growth within the intervertebral discs.[30] When contained in the nucleus of the disc, they serve these purposes without causing any irritation or pain. However, if they reach the one-third of the outer disc annulus that is innervated (or nerve branches of the spinal column) through fissures in the annulus or via disc herniation, they can trigger pain.

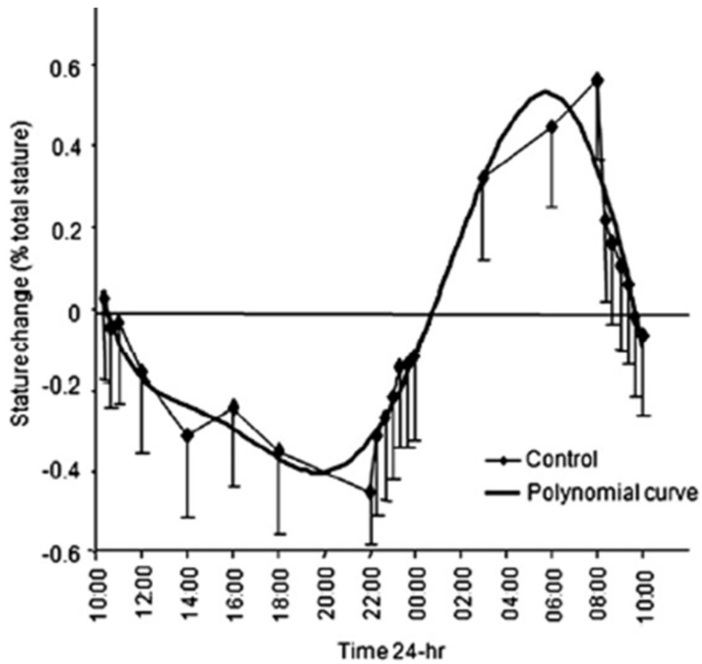

Figure 6-2. Change in height due to diurnal fluid flow into and out of intervertebral disc. (From Healey, et al., 2011[31])

The leakage of the proteoglycan materials through the disc has time- and stress-dependent components. Under greater stress, more leakage can occur. During the hours immediately after waking, most of the fluid leaves the disc after having imbibed fluid from the surrounding tissues through osmosis due to lower pressure in the disc while lying down during sleep. When one wakes up and rises from bed, because of the extra fluid in the disc, the bending stress on the disc is estimated to be four times greater than later on in the day[11]. So, in the hours immediately after waking, not only has most of the fluid transferred out of the disc (Figure 6-2), but the disc might also be more susceptible to injury due to the increased fluid in it. This theory also seems consistent with the medical finding that extended back rest prolongs disability, since by doing so you are allowing more time for fluid to return to the disc, so there is even more fluid and corresponding bending stress on the disc with prolonged bed rest.

The theory also accounts well for latency in pain onset, both for early morning flexion and events that highly stress the discs. Because it takes time for the inflammatory and/or noxious effect of the nuclear disc material to occur, associated pain can occur hours or even days later. This may be why back pain sufferers often report things like, "I felt something funny when I lifted that box and then the next day I was in excruciating back pain." Oftentimes pain sufferers cannot identify a specific event that triggered the pain, or only do so because they believe they will not receive medical attention if they cannot identify a triggering event[32]. The proteoglycan theory may offer a plausible explanation for these experiences; however, it is important to mention there is no consensus agreement from medical researchers on this issue and new theories continue to be developed and researched. The following section goes into detail on the foundations of the proteoglycan theory of low back pain causation.

6.2.2 Evidence for the Proteoglycan Source of Idiopathic Low Back Pain

There are two paths of inquiry when it comes to the role of proteoglycans in low back pain. One path explores the role of proteoglycans in affecting the mechanical properties of the disc, directly through their strong hydrophilic property, and indirectly through the interaction of increased loading, normal aging, and biochemical interactions that lead to changes in the constituency and structure of the disc. The other path of inquiry explores the effect of proteoglycans on tissues, namely the inflammatory effect, and the possible central sensitization to nociceptive windup ("the progressive increase in nociceptive neuronal responses to repeated C-fiber stimulation of constant intensity"[33]).

6.2.2.1 Proteoglycans and Mechanical Properties of the Disc

Adams and Muir[34] examined the biochemistry of the lower lumbar intervertebral discs from three cadaver specimens of ages 8, 16 and 44. They found that the 44-year old disc had more proteoglycans of smaller molecular size than the younger discs. Adams and Muir[34] postulated that the higher proportion of smaller proteoglycan molecules in the older disc may have been an indicator of increased collagen in the older disc. The authors recognized that with so few discs being examined, it was difficult to determine if the changes noted were as a result of normal aging or if pathological degeneration was responsible. Adams and Muir[34] suggested that these changes would likely result in significant changes in the mechanical properties of the disc. Adams et al.[35] reported examination of two discs (age 5 and 65) in addition to the three previously noted. With these additional discs they concluded that there exists a connection between water content and proteoglycan molecular size. These researchers reasoned that because:

1. As the disc ages, it goes from a highly hydrated nucleus (80%) to a less-hydrated fibrous nucleus, and,
2. The hyaluronic acid content (which has been associated with highly hydrated tissues) of the discs not only does not diminish, but actually increases in the nucleus,

Therefore, the water loss of the disc must be explained some other way – with the implication that the smaller molecular size of the proteoglycans in older discs is involved. Based on easier extractability in the assay process, they postulate that the smaller proteoglycan molecules have diminished association with the collagen fibers and may therefore weaken the tensile strength of these fibers in older discs. Their logic seems somewhat flawed in that the lower water content of older discs could also be explained by the higher proportion of collagen, not just the different proportion of proteoglycan molecular size.

Andersson and Schultz[36] recognized the importance of the nuclear disc hydration on the mechanical properties of the disc and therefore examined the influence of saline injections on the motion and intradiscal pressure of 16 cadaver discs. The relationship to proteoglycans was not considered, but the clear conclusion was that injected discs were stiffer, with less motion per unit load and intradiscal pressures higher by up to four times. Andersson and Schultz[36] reasoned, however, that the increased stiffness would not have much practical effect on range of motion, since the power of the back muscles could easily overcome the increased bending resistance. However, Andersson and Schultz[36] recognized that the increased intradiscal pressure due to the increased hydration could result in significantly greater disc stresses, affecting both the magnitude and distribution of forces on the vertebral end plates as well as all other disc structures.

Adams, et al.[37] examined the bending properties of the disc at different hydration levels, using both live subjects and in vitro lumbar discs. In the live subjects' experiment, hydration levels were varied by means of the diurnal variation that occurs when fluid is imbibed into the disc through the osmotic pressure during sleep and begins to flow out of the disc after waking and being subjected to the effects of gravity and movement. Maximum flexion in the morning and in the afternoon was measured using inclinometers and was found to be 5% greater in the afternoon (SD 1.9). For the cadaver lumbar spines, 19 motion segments (two vertebrae and the intervening disc) were tested. Forward bending was measured before and after creep loading, which was used to expel fluid content and to simulate different levels of load. Progressive dissection of vertebral ligaments during bending (on selected discs) was used to estimate the contribution of these ligaments to resistance to bending (which was estimated to contribute no more than a 20% variation). Disc height and bending moment were both reduced through creep loading. An interesting result of the creep loading was a decrease in prolapse under load. Very few discs prolapsed after the creep loading. Adams, et al.[37] believed this was so because there was less pressure on the posterior annulus of the disc due to the decreased disc hydration. Each motion segment had a before-after difference in bending of between 2 and 3 degrees and therefore an estimated total lumbar flexion difference of about 12.5 degrees (summing the vertebral segments). Adams, et al.[37] combined the living subjects bending data with the cadaver experiment results to estimate the increased bending moment resisted by the discs in the early morning compared to afternoon. The increase was dramatic, with early morning disc bending moment increased by 334% compared to the afternoon.

Urban and McMullin[38] examined 32 human lumbar discs in vitro, and found that proteoglycan content and hydration decreased with age and was lowest in the L5/S1 discs. Urban and McMullin[38] also made the important observation that the water content depends on the proportion of proteoglycans to collagen and that under stress, "all adult discs will have the same effective PG [proteoglycan] concentration, which will result in very different water contents…"[38] They were able to express the relationship between applied disc pressure and disc composition (ratio of proteoglycans to collagen) to hydration with the following formula:

$$Mt(P) = 1.33c + Xd/X(P)$$

Where:

- Mt(P) is the hydration of the disc in grams water/grams dry weight at an applied compressive stress of P (MPa)
- c = grams collagen/grams dry weight,
- X(d) = Fixed-Charge Density/grams dry weight (FCD is an indicator of proteoglycan content), and
- X(P) = Fixed Charge/available fluid at stress P

As shown in Figure 6-3, this formula fits closely to the experimental data.

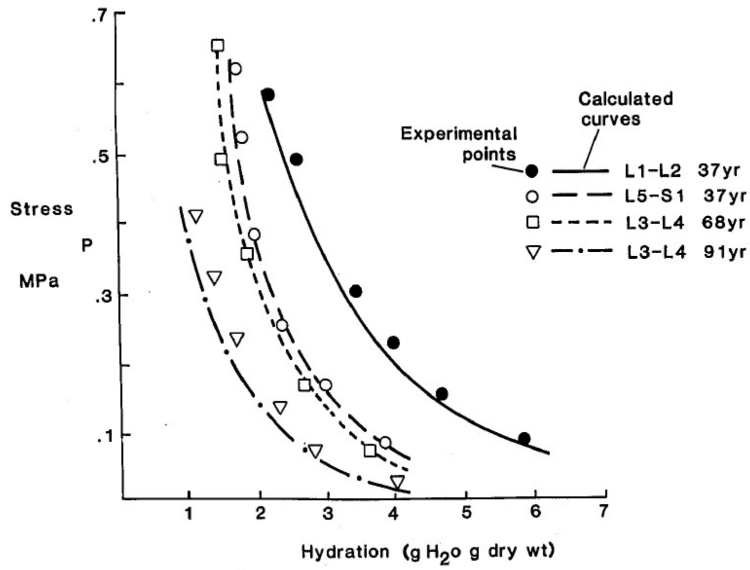

Figure 6-3. Calculated and experimental swelling pressure curves for selected discs. From Urban and McMullin[38].

6.2.2.2 Proteoglycans Effect on Other Tissues and their Relation to Pain

Based on guinea pig studies, Marshall and Trethewie[39] observed that the proteoglycans in the disc have an irritating, inflammatory effect on tissue and they postulated that disc-related pain is due to a local irritation of the nerve-root producing edema due to highly mobile amines produced in reaction to contact with the proteoglycans. Direct mechanical impingement of the nerve root is not needed to produce this chemically induced irritation.

Lipson and Muir[40] using surgical herniation of rabbit discs observed the production of fibrocartilage in the vacated nucleus of the discs, and were able to deduce that loss of fluid in the nucleus "signals an abortive repair attempt rather than that biochemical changes in proteoglycans initiate disc degeneration."[40] Lipson and Muir[40] also suggest that proteoglycans can be lost from the disc through annular radial fissures that are not to the point of disc herniation, but nonetheless the fluid loss can trigger this abortive repair process and lead to disc degeneration. The key point is that herniation of the disc is not needed to allow proteoglycans to contact tissues outside the disc, or the outer third innervated annulus.

Based on these previous (and other) findings about the chemical/inflammatory effects of proteoglycans, McCarron et al.[41] laid out a compelling theory for chronic back pain that says that fissures in the disc allow the inner fluids to leak into the surrounding tissues, causing painful inflammation. McCarron et al.[41] reasoned that these fissures may not heal well either because of the ongoing increased pressure from imbibed water, or because the disc tissue, having very little vascular intrusion, heals very slowly. McCarron et al.[41] went on to test the inflammatory properties of nuclear disc material on canine discs in vivo. Homogenized nuclear material (suspended in a saline solution) from the amputated tails was introduced daily to lumbar discs in four dogs. Four control dogs also received the saline solution, but without the nuclear material. Clear evidence of inflammation was found with the experimental subjects, but none for the controls. McCarron et al.[41] concluded that mechanical pressure is not needed to produce an inflammatory effect in the lumbar disc. The researchers admitted, however, that their experiment did not uncover the agent within or process by which the nuclear material produced the inflammatory response.

Takebayashi et al.[42] conducted a similar experiment on anesthetized rats, monitoring the neural activity of exposed lumbar nerve roots after application of nucleus pulposus (experimental group) and subcutaneous fat (both from amputated tails) were introduced. The dorsal root ganglion showed significantly higher excitability and hypersensitivity to mechanical agitation. The authors concluded that exposure of the dorsal root ganglion to nuclear disc material may be responsible for radicular pain. They associated this with herniated discs, but from Lipson and Muir[40] it is clear that a full herniation may not be needed.

Keshari, et al.[43] using nucleus material from nine discs removed from patients with discogenic pain and nine discs from patients with no pain (but with surgery-inducing deformities), found that the disc material from the subjects with pain had a significantly lower ratio of proteoglycans to collagen and lactate than the material from non-pain discs. The researchers concluded that proteoglycans, collagen, and lactate can be valid markers of disc-related back pain.

An important extension of the idea that the disc nucleus (i.e., proteoglycans) cause a localized inflammatory or immune[44] response in tissues contacted and thus affect nociception, is the notion that the effect of the neural response is central hypersensitivity. Cuellar, et al.[33] in a methodology similar to Takebayashi et al.[42] using 44 rats (22 experimental, 22 controls) found strong evidence for nociceptive dorsal horn neuronal windup. Specifically, introducing the nucleus pulposus (harvested from the discs at the base of the tail) to the L5 dorsal root ganglion and stimulating neuron firing through electrodes on the hind paw produced enhanced neuronal responses consistent with central sensitization (enhanced dorsal horn neuronal windup). In other words, the localized introduction of the nuclear material to the dorsal root ganglion results in a more general elevated sensitization to pain. Cuellar, et al.[33] were cautious in their interpretation, but "speculate that inflammatory agents released from (or recruited by) NP affect the dorsal root ganglion (and/or are transported to cord) to enhance primary afferent excitation of nociceptive dorsal horn neurons."[33] More recently, Brisby and Hammar[45] found rapid effects of enhanced neuronal activity at the thalamic level in rats who had nucleus pulposus material from their tails introduced to their sciatic nerve. They also articulate the importance of the growing recognition that neuropathy may not be due solely to mechanical impingement:

> The mechanisms behind the pain caused by disc herniation have been debated. While sciatica initially was considered solely to be the result of mechanical compression of the nerve root, it has in later years become generally accepted that nucleus pulposus (NP) itself can induce undefined chemical effects on dorsal root fibers and/or DRG [dorsal root ganglion] making these nervous structures more susceptible to mechanical compression.[45]

6.2.2.3 Discussion on Proteoglycan Theory of Back Pain Causation

The findings from the research reviewed can be summarized as follows. Proteoglycans have a direct impact on the water content of the disc. Disc hydration has a dramatic impact on the mechanical properties of the disc. Diurnal changes in disc hydration make for a greater than 300% (four times) increase in bending moment on the disc after waking from sleep. Disc fluid (mostly water and proteoglycans) decreases with age, is less abundant in the lower lumbar discs, and depends on both the disc composition (ratio of proteoglycans to collagen) and compressive force on the disc. As the disc ages, proteoglycans of smaller molecular size are found in greater abundance and these smaller proteoglycan molecules are more readily expelled through the annulus when the disc is under stress. Although substances other than the proteoglycans could be responsible, *something* in the nucleus pulposus has an inflammatory effect on tissues and probably even a central sensitizing effect on dorsal ganglion nerve roots. Herniation of the disc is not necessary for the disc fluid to move to the outer third of the disc (the innervated portion), resulting in pain, or to move out of the disc altogether, exposing the dorsal root ganglion to nuclear material, possibly resulting in nociceptive neuronal windup. The ratio of proteoglycans to collagen and to lactate in the disc may be a good biological marker for pain due to migration of nuclear material out of the disc, and implicates a central role of proteoglycans in back pain.

Lack of proteoglycans in the discs of patients with chronic pain may seem like evidence against the proteoglycans playing a role in the pain, but this is consistent with them playing a central role. The absence of them in the nucleus of the disc may mean that they have moved into the surrounding innervated areas in the outer annulus or outside the disc. It also may be an indication that there are fissures or herniations that have given the proteoglycans a pathway out of the disc, and consistent with the speculations of McCarron et al.[41], these pathways do not heal and provide a continuing supply of proteoglycans to the outside of the disc.

Because of the "extra" fluid in the disc when one gets up after sleep, the back is more prone to increased bending stresses as well as subject to the noxious/inflammatory effects of the proteoglycans. If this theory is true, back pain might decrease if the amount of stress on the back could be reduced during the hours immediately after getting out of bed after sleeping. This may also have a preventative effect on the onset of back pain.

In summary there are four ways in which the diurnal routine of fluid transfer in and out of the disc may contribute to LBP:

1. The first mechanism that may contribute to back pain is increased bending stress on the disc upon getting up from sleep.[11] Because of the fluid imbibing into the disc during sleep,[11] upon waking the static intradiscal pressure can be four times what it would be later in the day,[11] subjecting the disc to greater risk of new damage[46] immediately after rising from sleep and re-damage as the fluid (re-) opens pathways[47] to the innervated outer portions of the disc and external nerve roots. Consequently spine-loading activities soon after waking might play a role in increased disc damage and related pain. Unfortunately, after structural damage occurs, microfissures of the disc annulus become vascularized and innervated,[48,49] providing greater

opportunity for disc-related pain. This increased static intradiscal pressure therefore can contribute directly to back pain through increased disc damage and innervation (independent of proteoglycan flow) as well as indirectly through increasing proteoglycan pathways to innervated portions of the disc.

2. The second way in which the diurnal pressure changes and flow of fluids in and out of the disc may contribute to back pain is inflammation due to the proteoglycans themselves. Proteoglycans are known to cause pain in innervated tissues through an inflammatory response.[50] When innervated tissues are exposed to disc nuclear material (including proteoglycans) inflammation and pain results. While they are sequestered inside the nucleus of the disc, they cause no such response because the nucleus of the adult disc has no nerve endings and no direct blood supply.[51]
3. The third way proteoglycans may contribute to back pain is through neuronal windup[8] – sensitization of excitable neurons – which can account for sciatica,[52,53] once thought to be solely due to mechanical impingement on the nerve root.
4. The diurnal changes in intradiscal pressures with or without amplification by posture, movement, and external loads may also lead to degeneration of discs causing bulging into the foraminal space through which spinal nerves leave the spinal canal and cause mechanical impingement with mechanical irritation leading to an inflammatory (repair) response of those nerves causing pain with or without involvement of proteoglycans.

Increased stress on the disc during the first few hours after waking can amplify the above four pain-increasing mechanisms. It follows that decreased spinal stress during the hours after waking may decrease LBP. This idea was previously tested by Snook and colleagues in a semi-clinical study of people with mild-to-moderate chronic or recurring LBP.[12] They reported significant reduced back pain outcomes through teaching subjects to reduce their early morning stress on their backs, specifically control of early morning flexion. The Snook studies will be reviewed in greater detail later in this dissertation.

6.2.3 Conclusions on the Medical Cause of Low Back Pain

While many structures in the lower back can undergo injury-level damage either by degenerative changes over time or suddenly during traumatic injury, idiopathic low back pain is the most common, with a pathoanatomical etiology that has been elusive and complex. The progress of research to clarify the mechanical properties of the disc and their interaction with forces and the biochemical and structural composition of the intervertebral disc has led to a strong implication of the critical role played by proteoglycans in both the hydration of the disc (which plays a central role in the mechanical properties of the disc) as well as a key suspect in the triggering of and sensitization to pain. Applying the knowledge of the role of proteoglycans in low back pain causation is difficult, as evidenced by the fact that only one intervention[12] focused on this knowledge has been attempted. (Another avenue of application, however, has been suggested[44,54,55]: drugs aimed at immune or glial cells might be more effective than those aimed at the neurons themselves.)

There appears to be a strong logical case for controlling early morning flexion both from the increased mechanical stress standpoint as well as the control of fluid loss as a source of inflammatory pain causation. The biochemistry of the disc is very complex. Not only is there a likely primary inflammatory effect of proteoglycans, and a secondary sensitization effect, but the hydrophilic properties of the proteoglycans interact with mechanical stresses in terms of fluid content and production of new proteoglycans and collagen. In addition, the disc endplates (believed to be a primary source of nutrients for the nucleus pulposus) can degenerate, inhibiting nutrient (and oxygen) flow to the interior of the disc[56], while increasing blood vessel growth and nerve endings into the disc[56,57]. (Pain has been associated with ingrowth of blood vessels and nerve endings into the disc[57].)

On one hand "everything should be made as simple as possible, but not simpler"[58], and in the case of back pain, this, of course, is true. There are many interacting factors: age, proteoglycan molecular size, disc hydration, disc location (T1 versus L5), external compression and bending, immune/inflammatory response to proteoglycan/nucleus pulposus material, genetics, disc nutrition, cell proliferation, disc oxygenation, vascularization and innervation. Even with all these interactions, it seems plausible that much idiopathic low back pain is primarily due to *something* in the nucleus of the disc that leaks out through either herniations or microfissures in the annulus and either directly or indirectly through a biochemical reaction, triggers central, sensitizing pain through exposed nociceptive nerves.

There are at least three kinds of back pain experiential features that a valid model of low back pain will have to explain. The first is the delay in pain onset that is often experienced when "injury" is perceived as a result of a stressful task (e.g., "uh-oh, I think I just did something bad to my back"). Even though the "damage" is perceived, the pain often does not peak till the next day or two. The proteoglycan theory of pain causation is consistent with this delayed onset as the inflammatory effect is not immediate. The second feature is the speed of recovery. A valid model of disc pain will have to be consistent with observations of variations in recovery time through various treatment modalities. One common aspect of treatment where the proteoglycan theory is supported is the well-known recommendation to avoid bed rest[59] with back pain. The third feature that will need to be explained by a valid low back pain model is those people who never experience back pain. There is much to be learned by comparing individuals who have not experienced idiopathic low back pain and those who have. The key focus of such a comparison should be on genetic differences that relate to biochemical and biochemical variations.[60,61]

6.3 EFFECTIVENESS OF DIFFERENT TREATMENT APPROACHES

A good deal of research has been done to evaluate the effectiveness of back pain treatments. Reviews of the best quality research tend to conclude that the different treatment approaches have equal effectiveness, with some researchers concluding that little to no medical intervention is the best option. Although guidelines exist for clinicians on how to deal with patients presenting with back pain, there is not good adherence to these guidelines, resulting in over-diagnosis and overtreatment.

Carey and colleagues[62] found that among patients with acute low back pain, the outcomes are similar whether they receive care from primary care practitioners, chiropractors, or orthopedic surgeons. However, primary care practitioners provided the least expensive care for acute low back pain. Cherkin and associates[63] found that for patients with low back pain, the McKenzie method of physical therapy and chiropractic manipulation had similar effects and costs: "Patients receiving these treatments had only marginally better outcomes than those receiving the minimal intervention of an educational booklet." It should be pointed out that all these treatments were within a medical context. However, whether the limited benefits of these treatments are worth the additional costs is questionable. Researchers conducting the UCLA Back Pain study found[64] that chiropractic care and medical care for low back pain were comparable in their effectiveness. They also found that physical therapy may be marginally more effective than medical care alone for reducing disability in some patients, but the possible benefit is small. Other reviews[65,66] have found that there is no evidence that spinal manipulative therapy is superior to other standard treatments for patients with acute or chronic low back pain.

In a Cochrane review of research on the effectiveness of individual patient education on low back pain recovery, Engers, et al.[67] found that for low back pain patients with symptom duration less than 12 weeks (acute and subacute), 2.5 hours of individual oral instruction was "as effective as non-educational interventions on long-term pain and global improvement." Specifically, in studies where more than 2 hours of patient education was provided, "Individual education appeared to be equally effective to interventions like chiropractic manipulation and physiotherapy for patients with acute or subacute LBP." This included therapies such as the McKenzie technique, cognitive behavioral group therapy, interferential therapy, heat wrap therapy, group exercise therapy, and "manual therapy and exercise."

The conclusions of the most recent European guidelines for the management of low back pain recommend that unless there is a clear symptomatic indication otherwise, for both acute[68] and chronic[69] nonspecific low back pain, conservative treatments to reassure the patient, provide pain medication, encourage activity and exercise, and avoid bed rest are recommended. These guidelines recommend strongly against extensive diagnostic and treatment options, including surgery. The most recent US guidelines_ENREF_24[70] have similar recommendations, emphasizing self-care. They also point out that, "For most patients, first-line medication options are acetaminophen or nonsteroidal anti-inflammatory drugs." (The latter of these must be cautiously recommended because of association "with well-known gastrointestinal and renovascular risks.") The use of opioids in the treatment of low back pain, even when controlling for covariates such as injury severity, have been associated in a dose-response manner with longer disability, medical costs, and risk of surgery[71].

Over-diagnosis results in over-treatment[7,20,72] which has been acknowledged[71,73-75] as iatrogenic. Some specific diagnostic techniques have clearly been shown to be iatrogenic, namely magnetic resonance imaging (MRIs)[76,77], early opiate prescription[71], and discography[78]. A few researchers[79,80] have pointed this out that - much back pain disability is iatrogenic and to reinforce the favorable[7,18,62] natural history of back pain and the importance of the medical provider delivering coping counseling rather than overtreatment have quoted[80] Voltaire (François-Marie Arouet, 1694 –1778): "the art of medicine consists of amusing the patient while nature cures the disease."

Health care providers who follow accepted evidenced-based guidelines are preferred[75,81]. The European and US guidelines for the medical management of low back pain draw upon the best evidenced-based research that has been done and so, if followed, are the most likely methods to result in reduction of pain and disability. Yet historically, not all physicians closely follow these guidelines. Webster et al.[82,83] surveyed 720 physicians on how they would diagnose and treat low back pain with and without sciatica, neither with red flags such as cauda equina syndrome (a symptom of a serious lower back nerve problem characterized by numbness in the buttocks, genitalia and thigh, together with bowel and/or bladder dysfunction). Their treatment responses were compared with the then-current US guidelines for treatment[84] from the Agency for Health Care Policy and Research (now named the Agency for Health Care Research and Quality [AHRQ]). For the scenario without sciatica:

- 23% overall did not follow diagnostic recommendations
- 45% of General Practitioners did not follow diagnostic recommendations regarding the use of x-rays
- Depending on specialty, 50-67% selected bed rest for up to 3 days (not recommended)
- Depending on specialty, 25-60% recommended a short course of narcotics for pain reduction (not recommended)
- 16% overall recommended referral to a specialist (not recommended)
- 7% of general practitioners indicated they would consider surgical referral! (not recommended)
- General practitioners and physicians who had practiced longer were less likely to follow the guidelines.

For the scenario with sciatica:

- <u>Two-thirds</u> overall did not follow diagnostic recommendations regarding the use of x-rays
- Over 70% of general practitioners did not follow diagnostic recommendations.
- Depending on specialty, 17-31% selected extended bed rest – greater than 3 days (not recommended)
- Exercise (which is recommended) was only recommended by 45% of physicians
- 83% overall recommended referral to a specialist (not recommended)
- Nearly half of the physicians indicated they would consider surgical referral (not recommended)

- General practitioners and Physicians who had practiced longer were less likely to follow the guidelines.

Accepted medical management guidelines for nonspecific low back pain emphasize minimal diagnostic and treatment procedures during the first month of care. These treatment procedures largely fall under the category of self-care recommendations. It seems that even if evidenced-based medical treatment does make a substantial reduction in pain and disability (for which there is some evidence[81]), it may be hard to discriminate it from self-care – or simply recovery in keeping with the natural history of back pain without any care (see Carey, et al.[62]). Furthermore, the recommended diagnostic and treatment guidelines are often not even being closely followed, muting the potential benefit of medical intervention.

6.3.1 Advocates for Self-Care

If medical treatment beyond self-care does not reduce disability (or may, in some cases prolong it – e.g., recommendations of bed rest, opioid prescription), then what *can* be done to speed recovery? Some leading researchers have concluded that self-care (or educational instruction) may be the best option for people suffering from nonspecific low back pain: In typical clinical practice, most cases of LBP cannot be clearly linked to a known etiology; up to 85% of back pain is thus labeled idiopathic.[7] This etiological uncertainty probably contributes to the relative ineffectiveness of diagnosis and treatment.[131] Consequently the importance of conservative medical treatment,[132] reassuring patients,[133] self-efficacy,[89,90,97,134] and self-care,[72,96,135-137] has been emphasized.

Richard Deyo, Deputy Editor of Spine and a member of the Editorial Board of the Back Review Group of the Cochrane Collaboration:

> "The good news is that most back-pain patients will substantially and rapidly recover, even when their pain is severe. This prognosis holds true regardless of treatment method or even without treatment."[18]
>
> "For most patients, the best recommendation is a rapid return to normal activities, with neither bed rest nor exercise in the acute phase [first three weeks]."[17]

Waddell, in the most-cited book on back pain, The Back Pain Revolution, says "There is even an argument that we should discourage any health care for most low back pain and instead encourage people to deal with it themselves" and "Clinical impression and psychological studies suggest that patients who accept personal responsibility for their pain do better than those who leave it to others. Those who feel it is entirely up to doctors or therapists or someone else to cure them do worse."[7]

Fin Biering-Sørensen, former President of The International Spinal Cord Society: "Patients, health-care providers, and employers should be aware that neither sick-leave nor inactivity with bed-rest benefits recovery from low back pain. All involved in therapy of low back pain need to shift emphasis from dependence to self-management strategies."[85]

Carey et al.[62] in their review of the effectiveness of primary care physicians, chiropractors and orthopedic surgeons to manage back pain state that, "For acute low back pain, the best care may be minimal care." They then ask the rhetorical question, "Do our findings simply reflect the natural history of acute low back pain, with essentially no modification by medical or chiropractic care?"

Dr. James N. Weinstein, editor-in-chief of the journal Spine, in commenting about the importance of patient responsibility for health care decisions has said[86]:

"…if I had an acute backache, I would want to take two aspirin and try to keep moving. I would not want to go to the emergency room, I would not want a prescription painkiller, and I would not want to undergo radiography or magnetic resonance imaging. My decision about the management of my own backache would be strongly influenced by my beliefs, as an orthopedic surgeon specializing in backs, about the efficacy of invasive management for back pain, my aversion to the risks of surgery, and my conviction that aspirin and movement are as likely to be as effective in relieving my symptoms as surgery, at a fraction of the cost to me and to the health care system."

Snook[72] sums up the research by saying, "One of the messages for low back pain patients and their doctors is that sometimes less care is better - better for the patient and better for society."

Interestingly, many physicians agree that back pain generally gets better on its own without medical intervention. In the state of Washington, Cherkin et al.[87] found that 88 percent of family physicians and 28 percent of chiropractors believed that, "Most low back pain will resolve itself within a few weeks without professional help." Werner, et al.[88] surveyed physicians, physical therapists and chiropractors as well as their patients in three Norwegian countries and found the responses given in Table 6-1.

Table 6-1. Percent of respondents who agreed with the statements indicated. (Werner et al., 2005[88])

Health Care Provider Belief/Patient Belief	"Back pain recovers best by itself"	"In most cases back pain recovers spontaneously in a couple of weeks, no matter what we do"
Physicians	**74.6/24***	**85.5/46.5**
Physiotherapists	**38.0/15***	**54.2/30***
Chiropractors	**0/7***	**4.8/38***
Did Not Seek Care	**NA/29***	**NA/53.1**

*Estimated from the published graphs (not quantitatively described in the text).

A companion to the concept of self-care is the importance of self-efficacy. As Waddell[7] mentioned the importance of taking personal responsibility for one's pain, self-efficacy has been demonstrated[89,90] to be critical to recovery from back pain.

But can self-care work? There is some evidence that it can. In 1997 a campaign[91,92] was started in Victoria, Australia to alter public (and physician) opinions about back pain. The Australian state of New South Wales was used as a control group. In each state, data were collected via phone surveys and workers' compensation claims. In each state over 2,000 surveys were collected from the public and over 1,000 from general practitioners. The campaign cost was estimated at about $3 million (TV commercials, adds, billboards, seminars, evidenced-based information to health care providers, etc.). The content emphasis was on staying active, exercising, not resting for prolonged periods, and continuing with work. During the two and one half years of the campaign the state of Victoria experienced a 15% decline in back pain claims and a 20% reduction in claim medical costs. Days lost per claim also declined. The control state of New South Wales did not have these reductions. The researchers estimated they saved over $40M in direct costs for the $3 million investment. Three years after the campaign back pain belief improvements were still present[93,94].

A campaign similar to the Australian effort was carried out in Scotland[95]. Although they did not see any changes in workers' compensation rates or costs, they did demonstrate a significant and lasting shift in public opinion about staying active with back pain versus rest as a remedy. Initially, only 40% of the population felt that staying active was the right approach; after the campaign, and continually during three years of follow-up, 60% of the population felt that staying active was the right approach. The researchers speculated that the lack of workers' compensation or cost impact may have been due to their deliberate elimination of specific recommendations from the campaign materials to continue working.

The Australian campaign, in contrast, was focused on work-related low back pain (it also had a larger investment in TV media – the Scotland effort was largely radio and flyer-based) and included specific encouragement to continue working.

It should also be noted that the most recent treatment recommended by the American College of Physicians[96] for noninvasive treatment of acute, subacute, and chronic low back pain is essentially self-care. They point out that, "most patients with acute or subacute low back pain improve over time regardless of treatment" and therefore: "Clinicians should reassure patients that acute or subacute low back pain usually improves over time, regardless of treatment. Thus, clinicians should avoid prescribing costly and potentially harmful treatments for these patients, especially narcotics." They go on to say that the highest quality evidence is to treat acute and subacute back pain with superficial heat. Obviously use of superficial heat does not require medical intervention and so falls into the category of self-care. Likewise, exercise is the primary "treatment" recommended for chronic back pain – again, this can easily be considered a self-care treatment. A recent review[97] of clinical practice guidelines came to a similar conclusion: "Increasing evidence suggests the efficacy for self-management to improve low back pain outcome."

6.3.2 Red Flags

As compelling as the evidence is, advocacy of minimal health care or self-care would be irresponsible without some consideration for when an individual ***should*** seek medical attention. While there is a consensus among evidenced based medical diagnostic guidelines that the initial role of the physician diagnosing back pain should be to screen for more serious conditions[22], there is some controversy over how effective that screening is, given the "red flags" physicians use to prompt further investigation[27,98].

There also appears to be a gap in the literature between red flags that clinicians use to prompt further investigation and red flags that individuals should be aware of so that they can know when to talk to their doctor about the pain they are experiencing.

Lists of red flags for physician diagnostic purposes can be found in multiple authoritative publications[7,22]. Lists of red flags for individuals to use as a guide to know when to contact a doctor could not be found in the published literature, are difficult to find online, differ in their advice, and have changed over recent years. The current Medline Plus (a National Institutes for Health organization) advice for when to contact a physician is[99]:

> Most back pain goes away on its own, though it may take awhile [SIC]. Taking over-the-counter pain relievers and resting can help. However, staying in bed for more than 1 or 2 days can make it worse.
>
> If your back pain is severe or doesn't improve after three days, you should call your health care provider. You should also get medical attention if you have back pain following an injury.

The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), also a National Institutes of Health organization, currently also has advice[100]:

> In most cases, it is not necessary to see a doctor for back pain because pain usually goes away with or without treatment. However, a trip to the doctor is probably a good idea if you have numbness or tingling, if your pain is severe and doesn't improve with medication and rest, or if you have pain after a fall or an injury. It is also important to see your doctor if you have pain along with any of the following problems: trouble urinating; weakness, pain, or numbness in your legs; fever; or unintentional weight loss. Such symptoms could signal a serious problem that requires treatment soon.

This differs in detail and implications from the Medline Plus advice, with neither this advice or the Medline Plus advice providing definitive evidence for these guidelines.

In terms of validation of red flags used by physicians to detect serious pathologies, as mentioned previously, Henschke et al.[27] found that out of over 1,100 patients presenting back pain, only 11 had a serious condition, even with 1-year of follow-up to determine ultimate diagnosis. Most (8) of these serious conditions were fractures, and none were malignancies. The most startling thing about this study was that over 80% of the patients had at least one red flag present. In addition, red flags were only able to identify 5 serious pathologies and had an additional six false positives identified by red flags. The authors concluded that, "Only 3 of the red flags for fracture recommended for use in clinical guidelines were informative: prolonged use of corticosteroids, age >70 years, and significant trauma." Even this set of red flags need the extra element of the patient identified as a female to be "moderately" predictive, so that the authors concluded, "The status of a diagnostic prediction rule containing 4 features (female sex, age >70 years, significant trauma, and prolonged use of corticosteroids) was moderately associated with the presence of fracture." The Henschke et al. study illustrates both the rarity of serious pathology among patients presenting with back pain as well as the relative ineffectiveness of current screening methods to identify serious pathology.

Some[28] have gone so far as to say that the traditional use of red flags for screening patients presenting with back pain for serious pathology should be abandoned:

> Screening for red flags in individuals with low back pain (LBP) has been a historical hallmark of musculoskeletal management. Red flag screening is endorsed by most LBP clinical practice guidelines, despite a lack of support for their diagnostic capacity. We share four major reasons why red flag screening is not consistent with best practice in LBP management: (1) clinicians do

not actually screen for red flags, they manage the findings; (2) red flag symptomology negates the utility of clinical findings; (3) the tests lack the negative likelihood ratio to serve as a screen; and (4) clinical practice guidelines do not include specific processes that aid decision-making. Based on these findings, we propose that clinicians consider: (1) the importance of watchful waiting; (2) the value-based care does not support clinical examination driven by red flag symptoms; and (3) the recognition that red flag symptoms may have a stronger relationship with prognosis than diagnosis.

As to the changing guidelines for individuals to contact their doctor, Medline Plus used to have the following on their website[101]:

When to Contact a Medical Professional

Call 911 if you have lost bowel or bladder control. Otherwise, call your doctor if you have:

- Unexplained fever with back pain.
- Back pain after a severe blow or fall.
- Redness or swelling on the back or spine.
- Pain traveling down your legs below the knee.
- Weakness or numbness in your buttocks, thigh, leg, or pelvis.
- Burning with urination or blood in your urine.
- Worse pain when you lie down or pain that awakens you at night.
- Very sharp pain.

Also call if:

- You have been losing weight unintentionally
- You use steroids or intravenous drugs.
- You have never had or been evaluated for back pain before.
- You have had back pain before but this episode is distinctly different.
- This episode of back pain has lasted longer than four weeks.

If any of these symptoms are present, your doctor will carefully check for any sign of infection (like meningitis, abscess, or urinary tract infection), ruptured disk, spinal stenosis, hernia, cancer, kidney stone, twisted testicle, or other serious problem.

Based on comparison to the current Medline Plus guidelines, it is clear that the previous advice was overly conservative, encouraging unnecessary medicalization of benign back pain. The current Medline Plus guidelines quoted above, are sufficiently simple to allow for broad understanding, sufficiently specific ("after three days"), and do not go as far as to say "***see*** your doctor" (they say "call your health care provider"), so as not to unnecessarily medicalize common self-resolving back pain. The fact that bowel or bladder dysfunction is not mentioned is reasonable, given the reality that a rational person would seek medical attention immediately anyway if these conditions occurred.

6.3.3 Self-Care Recommendations

Snook[72] has said, "The data are not perfect, but there is sufficient evidence in the literature to suggest the following self-care guidelines. Depending upon the degree of compliance, the guidelines should provide assistance for most people with nonspecific low back pain." His recommendations for self-care are summarized as follows:

- Nonprescription analgesics for pain relief. (Heed manufacturers' warnings and instructions.)
- Remain as active as pain permits. Do not stay in bed.
- Ask your doctor if the McKenzie extension exercises[102] are right for you.
- Use ergonomic aids to reduce bending
- Take personal responsibility for managing your pain – don't expect others to fix you.
- Prevent the next episode by reducing heavy handling tasks and unnecessary bending.
- Reduce early morning bending (lumbar flexion).

This last point deserves further elaboration, since it is the focal point of the current study.

6.3.4 Reducing Early Morning Flexion

As described above, one theory to explain nonspecific low back pain is that proteoglycans in the disc irritate and/or inflame the innervated outer third of the intervertebral disc and surrounding tissues by leaking through fissures in the disc. This leakage is most rapid in the hours immediately after one gets out of bed after sleep. Also, because of the "extra" fluid in the disc when one gets up after sleep, the back is more prone to increased bending stresses as well as subject to the noxious/inflammatory effects of the disc nucleus materials (containing proteoglycans). If this theory is true, it would be expected that back pain would decrease if you could limit the amount of stress on your back during the hours immediately after getting out of bed after sleeping.

To test this theory, a research study was undertaken by Snook and colleagues[12]. Approximately 100 subjects were recruited who were:

- Experiencing persistent or recurring low back pain
- Between 20 and 60 years old
- Not under health practitioner care
- Never had back surgery
- Not filed a workers' compensation claim for back pain
- Not pregnant

Half of the subjects (treatment group) were taught to control early morning flexion (bending); the other half (sham group) were given a placebo ("sham") treatment of exercises known to have no effect on back pain. Specifically, the sham group received instruction on pelvic tilt, modified sit-up, double knee to chest, hamstring stretch, side leg raise, and cat and camel exercises. These were shown to be ineffective in reducing low back pain.[103] The instructions to the treatment group to reduce bending lasted about 45 minutes and were detailed, including an introduction to the proteoglycan theory of LBP and specific instructions of how to get out of bed, how to rearrange morning activities to eliminate the need for bending, toilet instructions and how to get dressed and even when and how to tie their shoes. The treatment group training also included recommendations on delaying "heavier physical activities" till later in the day. No bending whatsoever was recommended during the first two hours. Restrictions on bending continued up to 6 hours after waking. A back-scratcher and a pinching extended handle gripping tool were provided to each subject so they could reach things without bending. Even with over 90% of the subjects reporting difficulty in complying with the instructions and an average time of no bending lasting only one hour instead of the recommended two, significant reductions in pain, impairment and medication need were achieved. A baseline of pain and other measures were recorded on daily diaries for 6 months before the treatment and placebo instructions. After 6 months from the initial training, the control group was taught early morning flexion control and tracked for another 6 months. Sixty subjects completed the entire 18 months, with the results summarized in Table 6-2.

Table 6-2. Percent Reductions in Pain, Impairment, and Medication Need. Phase 1 reductions at 6 months represents 6 months of experimental group intervention and 6 months of control group (with Sham training). Phase 2 at 12 months represents 12 months of experimental group intervention and 6 months of control group intervention (after cross-over experimental training). From Snook, et al.[12]

Measure	Reduction at 6 months (Initial Experimental/Control Group)	Reduction at 12 months (Initial Experimental/Control Group)
Mean Pain Intensity	29%/6%	36%/19%
Mean Pain Days	23%/2%	31%/10%
Mean Disability Days	41%/6%	63%/48%
Mean Impairment Days	43%/14%	64%/45%
Mean Medication Days	38%/15%	39%/27%

In addition to the results summarized in Table 6-2:

- 35% of subjects reduced their pain by more than 50% after 6 months.
- 80% of the subjects said they intended on continuing early morning flexion control.
- Benefits of early morning flexion control were the same for young and old, male and female, with or without leg pain, and with or without high psychological overlay (e.g., depression).

- As might be expected, those who performed heavy physical work on their jobs did not benefit as much as those with moderate or light jobs.
- A follow-up study[104], 3 years after the end of this one, found that subjects who continued the treatment (50 subjects) reduced their number of pain days per month by 56% compared to baseline.
- A drawback of this study is that it did not include acute back pain, back pain associated with medical care, or workers' compensation claim related low back pain.

Until now, this research has not been replicated.

6.4 WORKPLACE INTERVENTIONS TO REDUCE LOW BACK PAIN

Despite the uncertainty of its clinical etiology and treatment, there is ample evidence that work-related low back injury including workers' compensation claim rates are higher among workers with more strenuous work tasks – especially tasks that exceed criteria derived from the National Institute for Occupational Safety and Health's (NIOSH's) Revised Lifting Equation[138] or Liberty Mutual's psychophysical tables.[139,140] Researchers have confirmed an association between the difficulty of a task using one of these criteria and the risk of a LBP claim,[141-144] often in a dose-response relationship. However, even if the initial LBP itself may not necessarily be due to strenuous work tasks,[145,146] strenuous work tasks may make continuing to work less likely once LBP occurs (for any reason – work or non-work etiology)[147].

Worksite-based efforts to prevent LBP have taken many paths, including training workers in safe lifting technique,[106,148-150] back belts,[151,152] worksite exercise programs,[153,154] placement efforts,[144] and redesigning tasks to reduce the risk of injury.[144] Critical reviews of the research found some evidence for the effectiveness of exercise[155-157] and multidisciplinary interventions[156,157] but little to no evidence for back belts or other interventions, including the very few ergonomic interventions that have been done in randomized controlled trials.[155,158-161] However, a Washington State Department of Labor and Industries review[159] of 250 case studies from peer-reviewed and non-peer-reviewed sources concluded that ergonomic interventions are cost effective to reducing musculoskeletal pain (including LBP) and its outcomes.

6.5 SUMMARY

Progress for low back pain relief will most likely come first by self-care approaches (e.g., control of early morning flexion) and later by more effective medical treatments (e.g., glial drugs, genetic treatments[105]). The self-care approach of reduced early morning flexion is severely underrepresented in research projects, with only the one such study conducted to date[12,104]. Although the Snook et al.[12,104] research had its limitations, the promise that it offered deserves additional research to either validate or refute the initial findings. The scope of such research should also be expanded to determine if the merit achieved for non-medicalized, non-workers-compensation cases will hold true for those that are part of the medical/workers' compensation systems.

7 REASEARCH METHODS

7.1 STUDY DESIGN AND PROCEDURES

This study tested the theory that back pain can be reduced (prevent new pain and reduce existing pain and pain duration) through the control (limiting) of flexion (bending), and other spine-loading activities such as exercise or lifting, during the first moments and hours after waking from sleep.

7.1.1 Study Aims

The specific aims of this study are:

1. To determine if a simple training presentation that encourages reducing spine-loading activities during the first two hours after waking can reduce low back pain outcomes.
2. To determine if time between waking and leaving for or arriving at work is correlated to low back pain outcomes.
3. To determine if exercise within the first two hours after waking is correlated to low back pain outcomes.
4. To determine if more spine-loading activities within the first two hours after waking are correlated to low back pain outcomes.

7.1.2 Informed Consent Process

Of 290 invited eligible custodians employed by the University of California at Los Angeles (UCLA) 157 (54%) were recruited between March 2012 and May 2012. The study was approved by UCLA's Institutional Review Board (IRB). Other than being currently employed as a custodian, no additional selection criteria were required to be eligible for the study. The IRB required all informational and consent content to have an emphasis on the voluntary nature of participation as well as the freedom to decline answering any individual questions. As a condition for employment, workers are required to be able to read and write in English, however, many are native Spanish speakers. Therefore, all informational, consent, and questionnaire materials were provided in both English and Spanish. All custodians, within 16 supervisor groups, attended two meetings led by either the university ergonomist or her ergonomic specialist using a script to ensure consistency. The first meeting was informational only, informing potential subjects of the proposed study, what their participation would entail, benefits, the voluntary nature of their participation and answering specific questions, confidentiality of their responses, and that there were no anticipated risks. Any questions potential subjects raised were answered. An informational flyer was provided in Spanish and English. The second meeting was to give prospective subjects the opportunity to read the informed consent form, ask questions, and complete the informed consent form for those choosing to do so. No mention was made of there being two training presentations (sham and treatment) at either meeting. Immediately following the consent meeting study participants completed the questionnaire and received training (either the treatment training or the sham training). The scripts used for the informational and consent meetings, the informational flyer, and the informed consent form used are included in the Appendices.

Prospective subjects were given the option to remain seated during the informed consent or return to their work duties should they decide to not give consent. Immediately following the consent meeting consented participants completed the questionnaire and all custodians received training (either the treatment training or the sham training).

7.1.3 Training Content

Each intervention was a brief (about 20 minute) in-person training session. The content of the treatment training included:

1. Explaining the aforementioned theory of back pain etiology in simple terms and using graphic images/video.
2. Mention of red flags that have been identified as indictors that the individual should contact a physician for their back pain.
3. Self-care for back pain[72] in the absence of red flags, including:
    a. Taking over-the-counter analgesics (following manufacturers' directions and warnings)
    b. Staying as active as possible, including recreational activities and exercise – and avoiding prolonged bed rest.
    c. Staying on the job and seeking accommodations from supervision, if needed.
    d. Controlling spine loading activities for the first few hours after waking. These activities included bending, lifting over 10 pounds, stretching, sitting, and exercise. This element of controlling early morning spine-loading activities took approximately 70% of the entire training session time and included video examples of how to avoid stress to the back during normal morning activities.

The sham (lifting) and treatment (bending) training were identical except for the recommendations mentioned in 3.d., above. Instead of control of early morning bending, the sham training presented generic lifting technique instructions (which are known to have no effect on back pain injury[106]). These lifting technique instructions took up the same amount of time (about 70%) as the control of early morning bending content. Care was taken to make sure that the word count for both presentations' scripts were nearly identical (only 34 words more in the treatment training script). The content for the sham training was based on nationally recognized safety organizations' (NIOSH, OSHA, and National Safety Council) lifting technique rules. The majority of this content came from Cal/OSHA's Ergonomic Guidelines for Manual Material Handling[107].

Each subject in both intervention groups received a laminated credit-card size reminder card with the basic content. The PowerPoint presentations (pdf versions) are included with the supplemental materials of this dissertation while the presenter scripts and reminder card content are provided in Appendices X and XI, respectively.

7.1.4 Subject randomization by Supervisor group

Subjects were assigned to the treatment or sham group based on randomized selection of their 16 supervisors to one group or the other. This clustered randomization approach was chosen in order to help minimize cross-over of the training content – i.e., workers sharing content from the sham training with the treatment-group workers and vice versa – as well as to facilitate administration of the training sessions. The randomization was achieved as follows:

a. The names of each supervisor were written on pieces of paper, and each put in a separate non-see-through envelope and the envelopes were sealed.
b. On a separate piece of paper, the following was written "Treatment: Heads/Tails".
c. The sealed envelopes and the "Treatment: Heads/Tails" paper was given to someone not involved in the research project in any way (an administrative assistant in the UCLA Environmental Health & Safety department), with the following instructions:

i. Thoroughly shuffle the envelopes and "deal" them equally into two piles, one on your right and one to your left. Shuffling should include but not be limited to dropping all the envelopes on a table, so they spread out individually and then corralling them back together again into a single pile.
ii. Write an "H" on each envelope on your right and a "T" on each envelope on your left.
iii. Flip a coin and circle either "Heads" or "Tails" on the paper provided.
iv. Return the paper and the envelopes.

d. The treatment group was all the envelopes with an "H," if "Heads" was circled, or all the envelopes with a "T," if "Tails" was circled.

7.1.5 Blinding

Neither supervisors, subjects, nor organization management were told that there were two different training versions. The sham trainers were a Certified Professional Ergonomist and a Safety Specialist. The sham trainers were aware that an experiment was being conducted and were informed there were two different training versions but did not know that one was considered a sham and one was considered the treatment, nor did they know they were providing a sham training. The treatment trainers were aware they were providing the treatment training. Both treatment trainers were certified professional ergonomists (CPEs), one with a Master's of Science in human factors. All trainers were employed by UCLA's Environmental Health and Safety department.

7.1.6 De-identified Subjects

Only the first page of the questionnaire had identifying information for the subjects to complete (name, employee id, department, and job title). Subjects were instructed, "Please do NOT put your name anywhere except the first page". The UCLA Ergonomist then assigned a random code to each subject and wrote that code onto the first and second pages and removed the first page. These codes were used as the subject identification numbers. All first pages were stored in a separate, locked file cabinet and were not shared with the graduate student researcher until the completion of the research. All questionnaires (with the first page removed) were then provided to the graduate student researcher and he transcribed the data from the questionnaires into an electronic data file. The UCLA Ergonomist also kept an electronic key relating subject names/IDs to their assigned code for any potential follow-up needed, but the key was not shared with the graduate student researcher.

7.1.7 Cross-Over Design

The intervention was delivered in a partial cross over design. At baseline, all consented subjects completed a questionnaire and after the baseline questionnaire was completed subjects (and non-subjects) were given training (within their supervisor group) in either the treatment content or sham content. A year later, consented subjects (who agreed to do so at that point in time) completed the questionnaire again and afterward all current workers (even those who did not complete the questionnaire) were given the treatment training. Thus, subjects in the sham group received the sham training after completing the baseline questionnaire and received the treatment training one year later, after completing their second questionnaire; subjects in the treatment group received the treatment training after completing the baseline questionnaire and received the same treatment training again, one year later, after completing their second questionnaire. Figure 7-1 shows the timeline of the experiment.

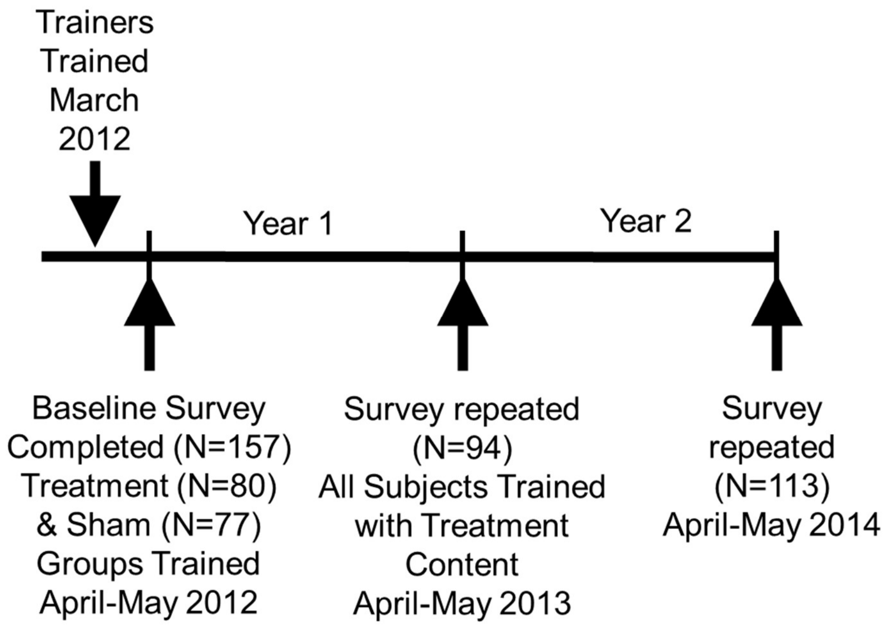

Figure 7-1. Timeline of partial cross-over intervention.

See Appendix I for the questionnaire with annotations on question sources, Appendix VI for the supervisors' informational meeting script, Appendix VII for the informational flyer, Appendix VIII for the informed consent meeting script, and Appendix IX for the informed consent forms.

At baseline there were 80 subjects in the treatment group and 77 in the sham group who completed the baseline questionnaire – 157 total. At the first-year follow-up 49 subjects from the original treatment group and 45 subjects from the original sham group completed their questionnaires – 94 total. At the second-year follow-up 57 subjects from the original treatment group and 56 subjects from the original sham group completed their questionnaires – 113 total. Of the 94 subjects who completed the first-year follow-up questionnaire, 79 (36 sham group subjects and 43 treatment group subjects) also completed the second-year follow up questionnaire; 34 subjects (20 sham group subjects and 14 treatment group subjects) who completed the second-year follow up questionnaire did not complete the first-year follow up questionnaire. Table 7-1 shows the number of subjects, by original group, who completed each survey. All 113 subjects who completed the second-year follow-up questionnaire also received the treatment training at the first-year follow-up even if they did not complete the first-year follow-up questionnaire.

Table 7-1. Number of subjects, by original group (sham or treatment), who completed each survey.

	Baseline Questionnaire	Year-one Questionnaire	Year-two Questionnaire
Sham	77	45	56
Treatment	80	49	57
Totals	157	94	113

7.1.8 Data Collection and Questionnaire Content

7.1.8.1 Questionnaire Content

The baseline questionnaire assessed socio-demographic factors, LBP in the prior 6 months, overall stress in the previous week, average typical times of sleeping and waking, time to leave for/arrive at work, having a second job, spine-loading activities after rising from sleep, occupational lifting burden, lifting technique, and beliefs about LBP self-resolution. A recall of 6 months was chosen as a compromise between shorter (and better) recall[108] and better covering recidivism and chronicity of back pain. The custodial department was not able to arrange for the follow-up at that time so the next survey and training was conducted one year after the initial survey and training. Consequently, most of the back pain measures reported on the baseline questionnaire are based on a 6-month recall while the year-1 and year-2 follow-up questionnaires were based on 12-month recall. There is some indication[109] that shorter recall periods result in "telescoping" (including events that occurred longer ago than the requested recall period), so it's possible that the 6-month recall is not very different than the 1-year recall. Nevertheless, for the baseline survey the total number of days with back pain was doubled and the corresponding three-level total number of days variable was recoded accordingly. The direct back pain measure of current back pain did not suffer from this recall difference, nor any of the adjustment variables.

Appendix I contains the actual questionnaire with annotations on the source of each question. Most demographic questions were taken from validated questions described by Aday and Cornelius[110] and most of the primary outcome measures were adapted from the pain diary used by Snook and colleagues in their research[12] on control of early morning flexion. A recall of 6 months was chosen as a compromise between shorter (and better) recall[108] and better covering recidivism and chronicity of back pain. For a description of all back pain outcomes, see Appendix II – Back Pain Outcomes.

7.1.8.2 Primary Outcome Measures

The primary back pain questions were adapted from the pain diary used by Snook and colleagues in their research[12] on control of early morning flexion. The back pain outcomes derived from the questionnaire questions are:

1. ***Any*** back pain. If any form of backpain was indicated by any of the responses given to any question.
2. ***Sciatica*** (#8. "Back pain extending past the knee").
3. ***Average*** back pain on a Numeric Rating Scale (NRS) of 0-10 (#10).
4. ***Worst*** back pain on a Numeric Rating Scale (NRS) of 0-10 (#9).
5. [a] ***Current*** back pain on a Numeric Rating Scale (NRS) of 0-10 (#11).
6. ***Total number of days*** with back pain (#7).
7. ***Longest episode*** of back pain (#6, None, less than 6 weeks, 6-12 weeks, 12 weeks or more – corresponding to acute, subacute, and chronic episodes).
8. [a] Taking ***Medication*** for back pain (#1).
9. Receiving ***Medical Care*** for back pain (#3).
10. [a] ***Limitations*** in usual work, home, or school activities.
11. [a]At least one ***Day Away from Work*** due to back pain (#4).
12. ***Average back pain severity (High vs low)***. Based on ***average*** back pain severity (#10) NRS< 4 = "Low" and >= 4 = "High".
13. ***Average Back Pain Severity (Four levels).*** Based on ***average*** back pain severity (#10) NRS: 0= "None", 1-3= "Mild-Moderate", 4-6= "Severe", and 7-10= "Very Severe".

[a] The four pain diary questions used by Snook et al., 1998.12.Snook SH, Webster BS, McGorry RW, Fogleman MT, McCann KB. The reduction of chronic nonspecific low back pain through the control of early morning lumbar flexion. A randomized controlled trial. *Spine.* 1998;23(23):2601-2607.

14. ***Total number of days with back pain per year (Three levels).*** 0= "None", 1-7= "1-7 Days", and 8-365= "8-365 Days" (#7).
15. ***Longest back pain episode (Three levels).*** Based on longest episode question (#6) with the top two categories collapsed: "None", "less than 6 weeks", and "6 weeks or more".
16. Workers' Compensation ***Claim.*** Self-reported filing of a workers' compensation claim (#5).

7.1.8.3 Assessment of spine-loading activities immediately after rising

Spine-loading home activities may include getting out of bed, dressing, putting on shoes, using the toilet, showering, getting food, sitting, lifting children, taking out the trash, exercising, and getting in and out of a vehicle. Work activities trigging LBP include forward flexion, twisting, and pushing, pulling, lifting, or carrying heavy loads at work.[11,111] Custodial work itself involves frequent bending (e.g., to lift trash cans). LBP onset is most frequently reported in the morning[112,113]. The baseline survey assessed four aspects related to spine-loading activities immediately after rising:

1. Time between waking and leaving for or arriving at work. Four variables characterize the time between waking and work. "Wake-To-Leave" was a continuous variable calculated from the difference between the typical time getting up from sleep and the typical time leaving for work as reported for surveys questions 13 and 14 (Appendix I). Follow-up questions revealed that all commuting to work (car, bus, train, or bicycle) involved sitting or other postural stresses to the spine, therefore commuting was considered a spine-loading activity and the time leaving for work was considered the beginning of that exposure. "Wake-To-Work" was a continuous variable calculated from the wake time and known work start times for subjects. From these variables, two dichotomous measures were created: "Wake-To-Leave≤2Hrs (yes/no)" and "Wake-To-Work≤2Hrs (yes/no)").
2. Spine loading activities during the first 2 hours after waking ("Activity") was assessed by question # 19, "On a typical work day, within the first two hours after getting out of bed, how much bending, sitting, and lifting (objects over 10 pounds) do you do?" with possible

responses of "None," "Minimal (sit on toilet, sit to put on socks and shoes)," "Moderate (up to half the time spent bending, sitting or lifting)," "Considerable (up to ¾ of the time spent bending, sitting or lifting)" and, "Nearly all the time is spent bending, sitting or lifting". Two alternative exposure variables were created from this question: a binary variable, "Activity Low/High," (low = "None," "Minimal," or "Moderate"; high = "Considerable" or "Nearly all the time") and ternary variable "Activity Low/Moderate/High" that used "moderate" for the middle category.

3. Two questions assessed performing exercises within the first two hours after rising from sleep: "On a typical work day, do you exercise or do any back stretching exercises within the first two hours after rising from sleep?" (Question 17) and, "Do you do the exercises during the UCLA 'Warm-up for work' that is given at the beginning of your shift?" (Question 18). Combining the answers to these two questions with information on when each subject's shift started, three additional categorical variables (yes/no) were created:
    a. "Exercise UCLA within 2hrs waking" was created to reflect exercise at work (UCLA) *within the 1st 2 hours after waking.*
    b. "Exercise home within 2hrs waking or UCLA" was created to reflect exercise at home within the 1st 2 hours after waking *or* at work (UCLA) during the beginning of the shift (regardless if the UCLA exercise occurred within 2 hours after waking). (Question 17 or Question 18)
    c. "Exercise home within 2hrs waking or UCLA within 2hrs waking" was created to reflect exercise at home or at work (UCLA) *within the 1st 2 hours after waking.*
4. Spine-loading activities *and* exercise within 2hrs after waking. This variable, "High Activity and Exercise" was created to reflect combinations of spine-loading activities and exercise within

2hrs of waking either at home or UCLA with seven ranked categories. For a detailed description and rationale see Appendix III – Activity-Exercise Categories.

7.1.8.4 Assessment of Covariates

The survey assessed individual (sex, age, preferred language, marital status, household income, years of school, perspective on medicalizing back pain, stress in the previous week, hours of sleep, and number of children under 6 cared for weekly), employment (tenure and having a second job), workplace (work shift/schedule and self-reported lifting technique), and physical workload (lifting over 25 pounds) factors. Long-duration (≥16 hours) night-shift work has been associated with disabling LBP[114] but in this cohort any work time exceeding an 8-hour shift was kept to a minimum (less than 5% overtime), therefore no shift duration data were collected. Psychosocial job stressors have been shown in reviews[115,116] of the epidemiological LBP literature to confound the associations between physical workload and LBP outcomes. Stress in the previous week was assessed by question 12 that was taken from the Back Disability Risk Questionnaire (BDRQ).[117]

7.1.9 Cost and Publishing

No fees were charged to UCLA for researcher time in development, execution, analysis or any other project-related activity. The UCLA Custodial department had the following internal **time** costs:

1. Time to select appropriate supervisor-employee groups and randomly assign them to either the Treatment or Sham Group.
2. Time for employees to complete the informed consent process, the demographic/back pain survey and receive the training.

3. Time for administration of the survey - receiving of survey forms, reminder cards and training media, distribution of the same, collection of survey forms, de-identifying surveys and returning them to the graduate student researcher.
4. Time to provide de-identified injury claim and work hour data.

The results of this research are expected to be published in two papers: one examining the cross-sectional results of the baseline questionnaire (section 9 of this dissertation) and one examining the impact of the intervention training on back pain outcomes (section 10 of this dissertation).

7.1.10 Benefits to Sponsoring organization

The past research[12] done on subjects with chronic back pain found that 6 months after the intervention, the median number of days associated with disability was reduced by 41% and after one year by 63%. UCLA Custodial Department had the opportunity to receive the following benefits:

1. Become a pioneer of a novel, low-cost intervention to reduce back pain.
2. Have better-informed workers on the etiology of back pain.
3. Have reduced back pain disability due to increased awareness of self-care methods (independent from control of early morning flexion)[92].
4. Potential for cost savings with workers' compensation claims.

7.2 DATA ANALYSIS

For the cross-sectional analysis of baseline questionnaire data, dichotomous, ordinal, and continuous outcome variables were analyzed using logistic, multinomial regression, and linear regression, respectively. Multinomial regression was chosen over ordered logistic regression for ordinal baseline data because the data did not comply with the assumptions necessary for ordered logistic regression. Current back pain, average back pain, worst back pain, total number of days in back pain were treated as continuous outcome variables. Primary analyses incrementally adjusted for variables that have been associated with LBP: age and sex :[118,119] (Model 1) and the following potential confounders: heavier workload[120-122] (number of lifts/day over 25 pounds), tenure[123], assigned shift[124,125], sleep duration[126,127], having more than one job[128], stress level[116,120], and questionnaire language choice (Model 2). All analyses were done with Stata/IC version 16.1, revision 15 Dec 2020[129].

Additional models (3 and 4) explored other potential confounders (e.g., small children at home), but due to missing values sample sizes became insufficient for reliable estimates (see online Supplement – Brogmus Additional Model Analyses):

Marital status, household income, and years of schooling, were not included in the analysis because missing values reduced the analytic sample by more than half. An alternate Model 1 restricted to the smaller sample of works with complete information in model 2 assessed if differences in effects in Model 1 and Model 2 were due to confounding or sample differences (see online Supplement – Brogmus Model1 Using Model2 Subjects).

For the prospective analysis of the intervention, the aforementioned "Model 2" variables used in the cross-sectional analysis were a-priori included as adjustment variables in the mixed effects analyses. Data that would be true across all surveys (e.g., age data) were used to complete any missing data on questionnaires from other years.

To test for differences between sham and treatment groups at baseline, the two-tailed t-tests were used for continuous variables and the Chi-squared test was used for categorical variables. See Appendix IV for these analyses results.

Because the data for the average, worst, current, and total number of days were heavily right-skewed (mostly zero-values) these variables were evaluated using mixed effects negative binomial regression analysis with the incident rate ratio (IRR) output option. For all dichotomous variables mixed effects logistic regression was used and for variables with ordinal outcomes mixed effects ordered logistic regression was used, both with the odds ratio (OR) output option. For all mixed effects analyses the default integration method "mvaghermite" (mean–variance adaptive Gauss–Hermite quadrature), default integration points (7), and the default 300 convergence iterations were used.

Predicted probabilities (for odds ratio outcomes – mixed effects logistic and ordered logistic regression) and predicted scores/counts (for incident rate ratios - for mixed effects binomial regression) were calculated by study period (baseline, one-year follow-up, and two-year follow-up) and intervention group (sham or treatment) using the Stata "margins" command, post mixed effects analyses. Margins calculated specified predicted values based on the model previously run – in this case the various mixed effects analyses – at fixed values of chosen variables – in this case intervention group (sham or treatment) at each survey period (baseline, year-one, and year-two).All prospective analyses were done with Stata/BE 17.0 for Windows (64-bit x86-64) Revision 05 Oct 2021[130].

The impact of the intervention on behaviors (time between waking and leaving for or arriving at work, activity level within 2 hours of rising, exercise at home within 2 hours of waking, exercise at UCLA at start of shift, and select combinations of activity level and exercise level) were evaluated using mixed effects linear regression for continuous variables (time between waking and leaving for or arriving at work), mixed effects logistic regression for dichotomous variables (exercise at home or UCLA), and mixed effects ordered logistic regression for variables with ordinal outcomes (activity level and combination activity-exercise levels). Mixed effects logistic and ordered regression was completed using the odds ratio (OR) output option. Mixed effects linear regression was estimated using the default maximum likelihood (ML) method. For mixed effects logistic and ordered logistic analyses the default integration method "mvaghermite" (mean–variance adaptive Gauss–Hermite quadrature), default integration points (7), and the default 300 convergence iterations were used.

For the behavioral variables, predicted probabilities (for odds ratio outcomes – mixed effects logistic and ordered logistic regression) and predicted times (for time between waking and leaving for work and time between waking and arriving at work) were calculated by study period (baseline, one-year follow-up, and two-year follow-up) and intervention group (sham or treatment) using the Stata "margins" command, post mixed effects analyses. All analyses of behavior outcomes were done with Stata/BE 17.0 for Windows (64-bit x86-64) Revision 05 Oct 2021[130].

8 RESULTS

Results have been summarized in two papers for publication. Section 8.1 presents the results of the cross-sectional analysis of the baseline data in a paper titled, "Spine-Loading Activities During the First Two Hours After Rising from Sleep and Low Back Pain in Custodial Workers". Section 8.2 presents the results of the prospective analysis of the intervention in a paper titled, "Can Training to Reduce Spine-Loading after Waking Reduce Back Pain in Custodians – Results from a Randomized Intervention Trial.". Results for the supplemental analysis of the intervention impact on behaviors is presented in Appendix V. The tests for differences in the baseline measures between sham and treatment groups are provided in Appendix IV.

8.1 RESULTS OF CROSS-SECTIONAL ANALYSIS OF BASELINE SURVEY

Characteristics of the study population are presented in Table 8-1. The majority were male (56%) chose English-language questionnaires (63%), and worked night shifts (starting around 5:30 p.m.; 77%). Average age and job tenure were 47.5 years and 8.4 years, respectively. Table 8-2 displays 6-month prevalence of LBP outcomes.

Table 8-1. Characteristics of the study population. UCLA custodians 2012 (N=157)

Characteristic (n responded)	N (Percent)	Mean ± SD	Range
Socio-demographic:			
Age in Years (n=157)		47.5 ± 9.9	21-76
Males	88 (56)	46.8 ± 10.7	21-76
Females	69 (44)	48.3 ± 8.8	24-63
Preferred Language (n=157)			
English	99 (63)		
Spanish	58 (37)		
Hours of Sleep Daily (n=145)		6.6 ± 1.6 Hours	2 – 12.5 Hours
Felt Stress in Past Week (n=142)			
None or a Little Bit of the Time	89 (63)		
Some or a Good Bit of the Time	41 (29)		
Most or All of the Time	12 (8)		
Years of School Completed (n=120)		10.2 ± 4.1 Years	0 – 16 Years
Believe back pain gets better on its own (rather than needing professional help) (129)			
Gets Better on Its Own	49 (38)		
Need Professional Help	80 (62)		
Marital Status (n=139)			
Married	66 (47)		
Living with Partner as Married	15 (11)		
Widowed	4 (3)		
Divorced	19 (14)		
Separated	11 (8)		
Never Married	24 (17)		
Household Income in $ (n=128)		36,797 ± 17, 181	$10,000 - $100,000
Number of Children ≤ 5 Years old cared for at least weekly (n=123, including 74 reporting 0)		0.72 ± 1.1	0 - 5

Work-related:			
Years Tenure (n=157)		8.4 ± 7.3 Years	2 weeks – 31 years
Shift (157)			
Day Shift	35 (22)		
Night Shift	122 (78)		
Average number of times/day lift something over 25 pounds (n=132)		5.5 ± 8.1	0 – 50
Has an Additional Job (n=151)			
Yes	15 (10)		
No	136 (90)		
Hours Between Waking and Leaving for Work (n=146)		4.5 ± 2.8 Hours	0 – 10.1 Hours
Wake to Leave for Work ≤2 hours			
Yes	43 (29)		
No	103 (71)		
Hours Between Waking and Arriving at Work (n=146)		5.7 ± 3.0 Hours	0.5 – 11.6 Hours
Wake to Arriving at Work ≤2 hours			
Yes	31 (21)		
No	115 (79)		
Bend with knees when lifting? (145)			
Yes	132 (91)		
No	13 (9)		
Spinal-Loading Activities:			
Activity during 1st 2 hours after rising from sleep (n=141)			
None	33 (47)		
Minimal	23 (32)		
Moderate	24 (34)		
Considerable	13 (18)		
Nearly all the time	7 (10)		
Exercise within 1st 2 hours after rising from sleep (n=150)			
Yes	75 (50)		
No	75 (50)		
Do the UCLA "Warm Up" Exercises (n=150)			
Yes	82 (55)		
No	68 (45)		
Exercise at home within 1st 2hrs after waking *or* at work during 1st part of shift. (n=150)			
Yes	63(81)		
No	37(47)		

Table 8-2. . Back Pain 6-month prevalence (except for "Back Pain Now"). UCLA custodians 2012 (N=157)

Back Pain Experience (n responded)	N (Percent)	Mean ± SD	Range
Any Back Pain (n=155) (Q10 response>0)	90 (57)		
Back Pain Radiating Past Knee (n=157) (Q8)	37 (24)		
Average Pain Severity (on 0-10 scale) (n=155) (Q10)		2.2 ± 2.8	0 - 8
Average Pain Severity (High: Q10>3) (n=155)	44 (28) (High)		
Average Pain Severity (n=155) (from Q10)			
None (Q10 Response = 0)	76 (49)		
Mild-Moderate (Q10 Response = 1-3)	35 (23)		
Severe (Q10 Response = 4-6)	24 (15)		
Very Severe (Q10 Response = 7-9)	20 (13)		
Worst Pain Severity (0-10 scale) (n=155) (Q9)		2.6 ± 3.3	0 – 9
Current[1] Pain Severity (on 0-10 scale) (Point Prevalence) (n=155) (Q11)		1.1 ± 2.1	0 - 8
Total Days with Back Pain (n=152) (Q7)		11.7 ±36.2	0 - 180
Total Days with Back Pain (n=152) (from Q7)			
0 Days	93 (61)		
1-7 Days	36 (24)		
8-180 Days	23 (15)		
Longest Episode of Back Pain (n=156) (Q6)			
None	100 (64)		
Up to 6 weeks	40 (26)		
6 to 12 weeks	8 (5)		
12 weeks or longer	8 (5)		
Duration Subacute/Chronic (n=156) (From Q6)			
None	100 (64)		
Up to 6 weeks	40 (26)		
6 weeks or longer	16 (10)		
Medication for Back Pain (n=155) (Q1)	50 (32)		
Health Care Provider Visit (n=155) (Q3)	18 (12)		
Activity Limitations (n=154) (Q2)	40 (26)		
At Least One Day Away from Work Due to Back Pain (n=155) (Q4)	18 (12)		
Filed a Workers' Compensation Claim for Back Pain (self-reported) (n=155) (Q5)	7 (5)		
Record of a Workers' Compensation Claim for Back Pain (n=157) (From company records)	1 (0.6)		

1. Low back pain point prevalence, not 6-month prevalence.

8.1.1 Effects of Wake Time Duration Before Work

Table 8-3a shows effects of Wake-To-Leave and Wake-To-Work time per hour (continuous measure) and for durations of two or more hours (dichotomous measure) on 6-month pain outcomes with 95% confidence intervals (CIs), and p-values. (Figure 8-1 shows the unadjusted mean pain severity scores for average, worst, and current pain by wake-to-work times less than and more than 2 hours.) In the fully adjusted model 2, pain outcomes generally decreased with increasing durations. The effect was most consistent for any form of back pain ("Any Back Pain") and sciatica ("Back Pain Radiating Past Knee"). Every hour between waking and leaving for work or starting work reduced the odds of Any Back Pain by about 15% (OR=0.85) sciatica by about 13% (OR=0.87). When Wake-To-Leave and Wake-To-Work times were less than two hours, the odds increased by 119% (OR=2.19) and 38% (OR=1.38), respectively, for Any Back Pain, and about 2.5-fold (OR=2.52) and over 8-fold (OR=8.14), respectively, for sciatica. In addition, for each hour between waking and working (Wake-To-Work), Worst Pain Severity decreased by 0.28 (95% CI-0.55-0.00, p=0.049) points on the 0-10-point Numerical Rating Scale (NRS) Pain severity scale. Since the mean worst pain reported was 2.65, this 0.28 decrease reflects an approximately 11% decrease in mean worst pain severity for each hour. Longer wake-to-work times were associated with fewer total days in pain but with longer pain episodes.

8.1.2 Effects of Activities During the First Two Hours After Waking

Table 8-3b shows effects with 95% CIs for 2, 3, and 5 levels of activity within the first two hours after waking. Higher levels of activity were consistently associated with higher levels of LBP-related outcomes. (Figure 8-2 shows the unadjusted mean pain severity scores for average, worst, and current pain by the five activity levels.)

Activity – 2 Levels

High activity during the first two hours after waking compared to a low level was associated with a 2–fold increase on the 0-10-point NRS pain scale. Since the reported mean Average Pain Severity was 2.24 points, this reflects a 91% increase in mean Average Pain Severity. High activity was associated with over 10 times (OR=10.69; 2.75-41.55) higher odds of being in the high Average Pain Severity level (pain scale values of 4-10) than the low Average Pain Severity level (values of 0-3). High activity was associated with a 22% lower risk for Mild-Moderate pain ratings (relative risk [RR] =0.78; 0.18-3.40), but 669% and 1,591% higher risk for Severe and Very Severe levels (RR=7.69;1.39-42.51, and 16.91;2.47-115.59, respectively). Higher activity was also associated with increases of 74% of the average and worst pain severity and 77% of the current pain severity.

High activity was associated with 9 more days with back pain per year. Results varied by duration of LBP episodes. High activity was associated with 380% higher risk for LBP episodes of up to 6 weeks (RR=4.75and 4.87, for the 3-level and 4-level Longest Episode of Back Pain variable, respectively), but about 38% lower risk for "6 weeks or longer" and "6 to 12 weeks" (RR=0.63and 0.61for the 3-level and 4-level Longest Episode of Back Pain variable, respectively) – although these relative risk ratios had much wider confidence intervals than the "Up to 6 weeks" levels had.

High activity was also associated with about 80-100% higher risk of Medication for Back Pain, Health Care Provider Visit, and Activity Limitations (OR=1.81, 1.88, and 1.98, respectively). The only outcome variable that did not show increased risk due to High Activity was "At Least One Day Away from Work Due to Back Pain" (OR=0.54;0.09-3.32).

Similar results were observed for 3- and 5-level Activity outcome variables, however, a potentially protective effect of Moderate Activity emerged from this more detailed exposure variable.

Activity – 3 Levels

When Activity responses were grouped into three levels (None-Minimal, Moderate, Considerable-Nearly-All-the-Time) Moderate activity was associated with 84% lower odds of high Average Pain Severity (High/low) (OR=0.16;0.03-0.75), while high activity had 407% higher odds of high Average Pain Severity (High/low) (OR=5.93; 1.45-24.30). Similarly, moderate activity was associated with 1.12 points lower Average Pain Severity on the NRS 0-10 pain scale (-1.12; -2.31-0.08) and Considerable-Always activity was associated with 1.65 points higher Average Pain Severity (1.65; 0.36-2.95). With the mean of Average Pain Severity of 2.24, this suggests that compared to low activity moderate activity will decrease Average Pain Severity by 50% but high activity will increase Average Pain Severity ratings by 74%. A similar pattern was found for Worst Pain Severity and Current Pain Severity.

Activity – 5 Levels

Compared to None (no spine-loading activities within the first two hours after waking), all levels of activity except Moderate were associated with higher risk of Any Back Pain, Back Pain Radiating Past Knee, Average Pain Severity (both NRS 0-10-point pain scale and High/Low), Worst Pain Severity, and Activity Limitations. The strongest effects were seen with "Nearly All the Time" activity for Very Severe Average Pain Severity (RR=46.56; 0.67-3,248.91), Total Days with Back Pain (39.30; 8.96-69.64 days), and Total Duration of Back Pain 8-180 Days (RR=10.75; 0.56-207.80).

Considerable activity had larger increased risk effect sizes than the highest activity ("Nearly All the Time") for many of the back pain outcomes. This was true for Back Pain Radiating Past Knee, Average Pain Severity (both NRS 0-10-point pain scale and High/Low), Worst Pain Severity, and Health Care Provider Visit, however the number of Nearly All the Time respondents were low (3 or 7) which may be partially responsible for imprecise estimates.

8.1.3 Effects of Exercise at Home and/or UCLA

Table 8-3c shows the effects of exercise at home within two hours of waking, exercise at UCLA, exercise at UCLA within two hours of waking, and combinations of these. Exercise at home within two hours of waking was largely protective against back pain outcomes while participation in the on-site UCLA exercises at the beginning of the shift had mixed results. (Figure 8-3 shows the unadjusted mean pain severity scores for average, worst, and current pain by exercise at home within two hours of waking.)

Exercise at Home

Exercise at home within the first two hours of waking were mostly associated with reduced LBP. The strongest decreases were seen for short LBP episodes (Total Days with Back Pain lasting 1-7 days RR=0.50; 0.19-1.32 and having At Least One Day Away from Work Due to Back Pain OR=0.39; 0.10-1.51). Overall, however, exercise at home within the first two hours of waking was associated with 7.79 (-3.89-19.47) additional Total Days with Back Pain.

Exercise at UCLA

UCLA's "Warm up for work" exercises were associated with lower average and worst pain severity short LBP episodes (Up to 6 weeks), Medication for Back Pain, Health Care Provider Visit, Activity Limitations, and Having at Least One Day Away from Work Due to Back Pain, but higher risks for Any Back Pain, Back Pain Radiating Past Knee, Mild-Moderate Average Pain Severity, Total Days with Back Pain, and Longest Episode of Back Pain 6 Weeks or longer. These results had very wide confidence intervals.

Exercise at UCLA *within* 2 hours after waking

For custodians who participated in the "Warm up for work" *within* 2 hours after waking, the effects on almost all back pain outcomes were protective. Higher risk was only associated with Back Pain Radiating Past Knee, Current Pain Severity, and Longest Episode of Back Pain 6 Weeks or longer. Very wide confidence intervals limit interpretation of the results.

UCLA exercises within 2 hours of waking was associated with low odds of high Average Pain Severity (OR = 0.15; 0.01-2.13), low risk for the Longest Episode of Back Pain up to 6 weeks (RR = 0.16; 0.01-1.90). Effects estimates for Total Days with Back Pain showed low precision (1.97; -25.89-21.95 days).

Exercise at Home or UCLA

All custodians who either exercised at home (within 2 hours after waking) or participated in the UCLA "Warm up for work" exercises (whether or not it was within 2 hours after waking) had lower risk of all back pain outcomes except for Mild-Moderate levels of Average Pain Severity, and Total Days with Back Pain (4.13 more days; CI=-9.00-17.25). The risk of the Longest Episode of Back Pain was reduced by 57% (RR = 0.43; 0.17-1.13) and the odds of having Activity Limitations were reduced by 68% (OR = 0.32; 0.12-0.84).

Exercise at Home or UCLA within 2 hours after waking

Workers who either exercised at home or participated in the UCLA "Warm up for work" exercises (both within 2 hours after waking) also showed lower risk for all back pain outcomes except for Total Days with Back Pain that increased by 7.89 days (-3.90-19.69).

8.1.4 Effects of combined activity and/or exercise (home or UCLA) within 2hrs of waking

Table 8-3d shows that the combined impact of activities and exercise within 2 hours of waking (home or UCLA) depended on the type of combination. (Figure 8-4 shows the unadjusted mean pain severity scores for average, worst, and current pain by the seven activity/exercise levels.) The most consistent trend was for the category of High Activity (Considerable or Nearly all the time) and no (None) exercise (home or UCLA) within 2 hours of waking ("High Activity/No Exercise") which was associated with increased risk for Any Back Pain (OR = 10.30; 0.82-129.57), Back Pain Radiating Past Knee (OR = 11.74; 1.37-100.22), Average Pain Severity (NRS 0-10-point pain scale; 2.48; 0.42-4.55), Average Pain Severity (High/Low; OR = 11.94; 0.97-147.24), Average Pain Severity (Mild-Moderate, Severe, Very Severe; RR = 4.99, 14.23, and 104.76, respectively), Total Days with Back Pain (11.08; -14.92-37.09 days), Total Days with Back Pain (1-7 Days and 8-180 Days; RR = 12.79 and 8.09, respectively), Medication for Back Pain (OR = 8.01; 1.02-62.65), Health Care Provider Visit (OR = 4.35; 0.35-54.48), Activity Limitations (3.06; 0.38-24.43), and At Least One Day Away from Work Due to Back Pain (OR = 6.28; 0.51-77.54). With the mean of Average Pain Severity of 2.24, this suggests a 111% increase in Average Pain Severity for workers who have high activity but do not engage in exercise within 2 hrs after waking. With means of 2.65 and 1.08 for Worst Pain Severity and Current Pain Severity, respectively, this suggests increases of Worst Pain Severity ratings of 77% and Current Pain Severity ratings of 65%.

Custodians who had High Activity (Considerable or Nearly all the time) and had exercise (home or UCLA) within 2 hours of waking ("High Activity/Exercise") also had increases in risk, although to a lesser degree. The largest risk increases were seen for Average Pain Severity (High/Low; OR = 4.70; 0.71-31.17) and Total Days with Back Pain (9.22; -12.25-30.70).

Minimal Activity and exercise (home or UCLA) within 2 hours of waking ("Minimal Activity/Exercise") was also associated with increases in risk for most back pain albeit those effects were imprecise as indicated by wide confidence intervals.

In contrast, Moderate Activity and exercise (home or UCLA) within 2 hours of waking ("Moderate Activity/Exercise") were associated with decreases in risk for most back pain outcomes: by 59% of the mean of Average Pain severity, 92% of high Average Pain Severity (High/Low; OR = 0.08; 0.01-0.99), 58% the mean Worst Pain Severity, 44% of the mean Current Pain Severity. LBP disability outcomes also showed negative associations: Total Days with Back Pain 1-7 Days (RR = 0.11; 0.01-1.33), Activity Limitations (OR = 0.47; 0.09-2.50), and At Least One Day Away from Work Due to Back Pain (OR = 0.57; 0.05-6.79). However, risks increased for sciatica (Back Pain Radiating Past Knee, OR = 1.82; 0.29-11.45), and the overall duration of LBP (Total Days with Back Pain 12.07; -8.68-32.83 days).

The combination of Moderate Activity and no (None) exercise (home or UCLA) within 2 hours of waking ("Moderate Activity/No Exercise") was associated with increased risk for Back Pain Radiating Past Knee (OR = 1.57; 0.20-12.46), Average Pain Severity Mild-Moderate (RR = 1.42; 0.25-7.99), Longest Episode of Back Pain 6 weeks or longer (RR = 1.46; 0.13-16.56), Medication for Back Pain (OR = 4.00; 0.77-20.79), Health Care Provider Visit (OR = 2.09; 0.23-18.68), Activity Limitations (OR = 1.27; 0.26-6.18), and At Least One Day Away from Work Due to Back Pain (OR = 3.91; 0.54-28.48). However, risk decreased by 23% for the mean Average Pain Severity, Average Pain Severity (High/Low; 0.31; 0.04-2.52), Average Pain Severity Severe (RR = 0.23; 0.01-3.87), Average Pain Severity Very Severe (RR = 0.71; 0.04-13.48), 20% of the mean Worst Pain Severity, 127% of the mean Current Pain Severity, and for Total Days with Back Pain (-2.36; -24.15-19.44 days).

Minimal Activity combined with no (None) or missing data for exercise (home or UCLA) or no activity (None) and exercise (home or UCLA) within 2 hours of waking ("Minimal Activity/Minimal Exercise") tended to be associated with increased risk although very wide confidence intervals limit interpretation of the results and examination of Model 1 results using Model 2 subjects suggests that loss of certain subjects may have contributed to the magnitude and direction of the effects seen in Model 2 rather than just controlling for confounding.

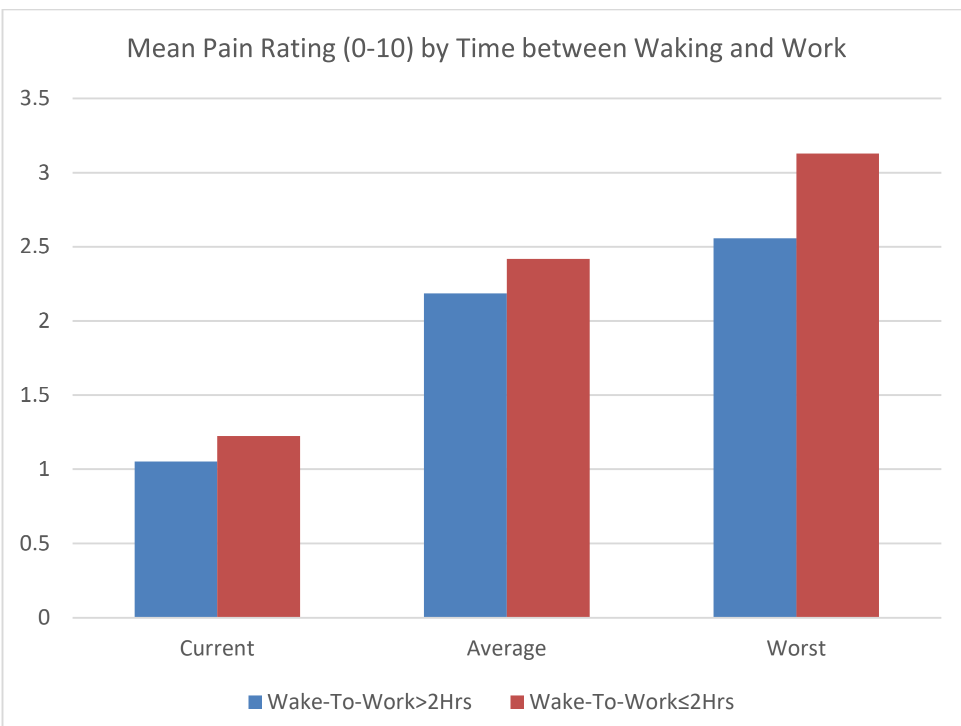

Figure 8-1. Mean Numerical Rating Scale (NRS) range of 0-10 (0="No pain"; 10="Most severe pain") Pain ratings for current, average, and worst back pain by time between waking and work.

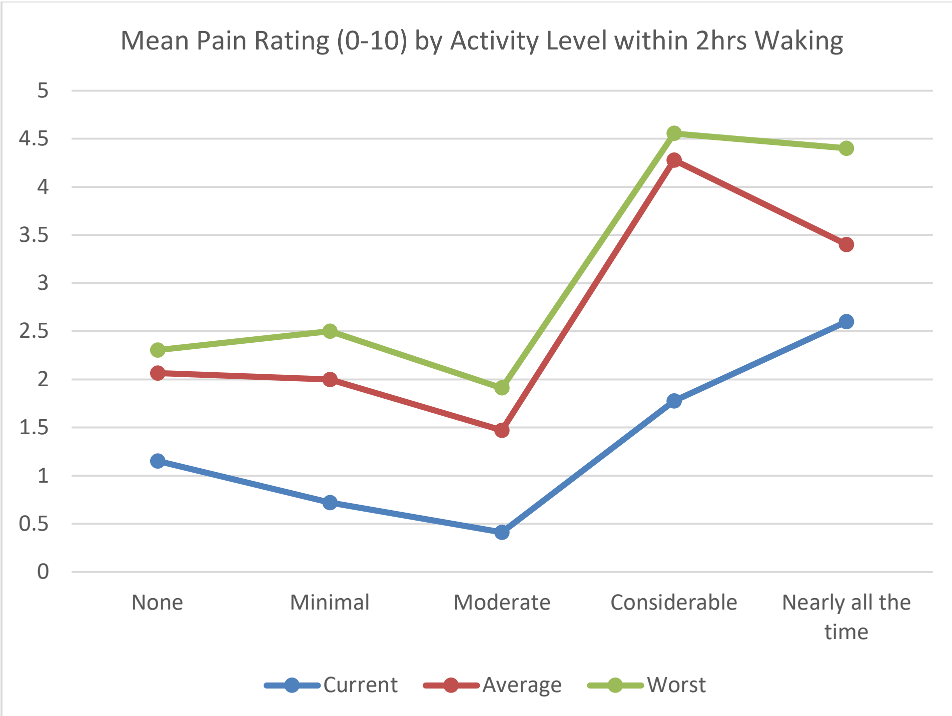

Figure 8-2. Mean Numerical Rating Scale (NRS) range of 0-10 (0=”No pain”; 10=”Most severe pain”) Pain ratings for current, average, and worst LBP by activity level during the two hours after rising. Activity defined as bending, sitting, and lifting objects over 10 pounds with answer categories: none, minimal (=only sitting on toilet and sitting to put on socks and shoes); moderate = up to half the time; -Considerable = ¾ of the time; -and nearly all the time spent bending, sitting or lifting.

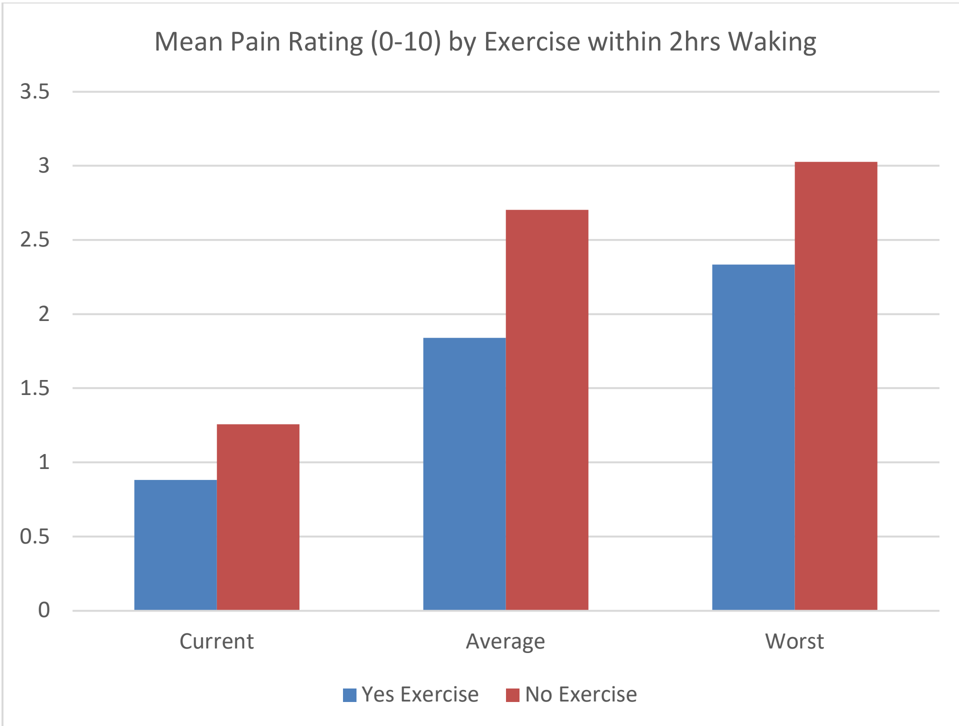

Figure 8-3. Mean Numerical Rating Scale (NRS) range of 0-10 (0=”No pain”; 10=”Most severe pain”) Pain ratings for current, average, and worst back pain by exercise at home within two hours of waking.

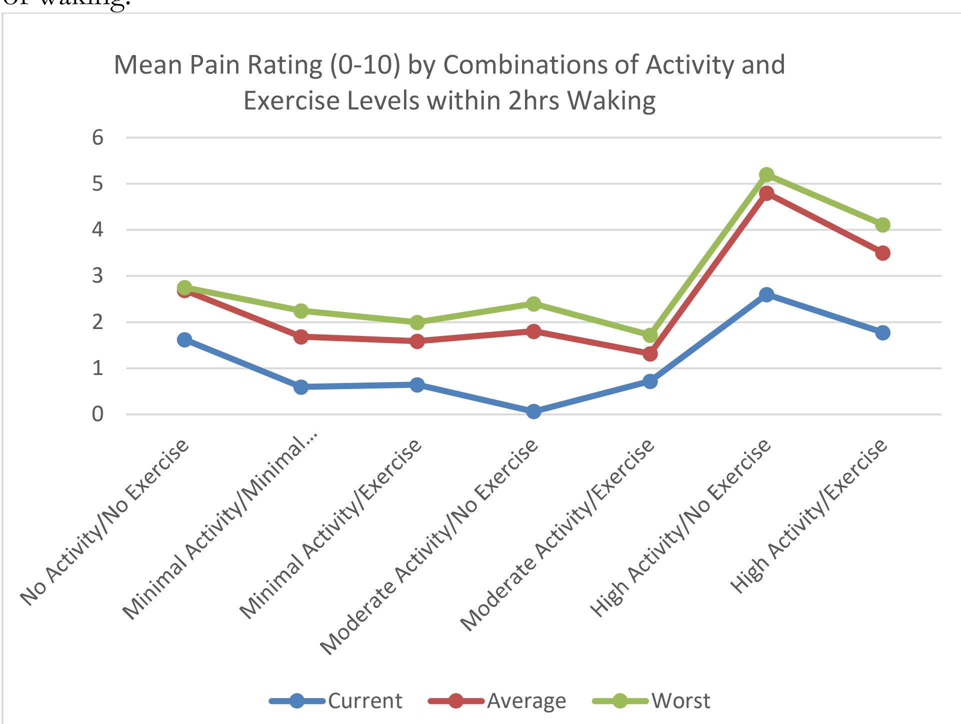

Figure 8-4. Mean Numerical Rating Scale (NRS) range of 0-10 (0=”No pain”; 10=”Most severe pain”) Pain ratings for current, average, and worst back pain by activity-exercise combinations.

Table 8-3a. Association between wake time duration before work and 6-month prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
***Wake-To-Leave* [hours]**															
Any Back Pain [Yes/No]	0.96	0.85	1.08	0.503	146	0.96	0.85	1.09	0.534	146	0.85	0.69	1.06	0.157	114
Back Pain Radiating Past Knee [Yes/No]	1.01	0.88	1.16	0.861	146	1.01	0.88	1.16	0.859	146	0.87	0.66	1.15	0.332	114
Average Pain Severity [NRS *0-10]*	0.02	-0.15	0.18	0.818	144	0.02	-0.14	0.19	0.773	144	-0.02	-0.27	0.23	0.876	114
Average Pain Severity [High/Low]	1.00	0.88	1.14	0.978	144	1.00	0.88	1.15	0.947	144	0.93	0.73	1.18	0.556	114
Average Pain Severity [reference: None]					144					144					114
Mild-Moderate	0.94	0.81	1.09	0.400		0.94	0.81	1.09	0.407		0.85	0.66	1.09	0.196	
Severe	0.92	0.78	1.09	0.336		0.93	0.78	1.10	0.380		0.79	0.58	1.09	0.148	
Very Severe	1.06	0.88	1.29	0.529		1.07	0.87	1.30	0.533		0.96	0.65	1.42	0.838	
Worst Pain Severity [NRS 0-10]	-0.06	-0.26	0.13	0.518	144	-0.06	-0.25	0.14	0.568	144	-0.11	-0.41	0.19	0.465	114
Current Pain Severity [NRS 0-10]	0.05	-0.07	0.18	0.419	144	0.05	-0.07	0.18	0.402	144	0.11	-0.08	0.30	0.256	114
Total Days with Back Pain	-0.10	-2.19	1.98	0.922	141	-0.08	-2.17	2.01	0.943	141	1.11	-2.01	4.23	0.482	111
Total Days with Back Pain [reference: No back pain]					141					141					111
1-7 Days	0.96	0.83	1.11	0.592		0.97	0.83	1.12	0.642		0.77	0.60	0.99	0.045	
8-180 Days	1.00	0.84	1.19	0.995		1.00	0.84	1.19	0.997		1.23	0.87	1.73	0.248	
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	1.05	0.92	1.20	0.476		1.06	0.92	1.22	0.392		0.95	0.76	1.19	0.655	
6 to 12 weeks	1.12	0.84	1.49	0.427		1.13	0.84	1.51	0.412		1.32	0.83	2.09	0.235	
12 weeks or longer	0.81	0.60	1.11	0.189		0.81	0.60	1.10	0.183		0.00	0.00		0.991	
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	1.05	0.92	1.20	0.477		1.06	0.92	1.22	0.404		0.97	0.77	1.21	0.763	
6 weeks or longer	0.96	0.78	1.18	0.708		0.96	0.78	1.18	0.722		1.18	0.81	1.72	0.392	
Medication for Back Pain [Yes/No]	1.05	0.92	1.19	0.478	144	1.05	0.92	1.19	0.475	144	0.94	0.76	1.17	0.588	112
Health Care Provider Visit [Yes/No]	0.99	0.82	1.19	0.889	144	0.98	0.81	1.19	0.858	144	0.93	0.69	1.25	0.633	112
Activitiy Limitations [Yes/No]	1.03	0.90	1.18	0.696	143	1.03	0.90	1.18	0.648	143	1.07	0.85	1.33	0.578	111
At Least One Day Away from Work Due to Back Pain [Yes/No]	1.13	0.94	1.37	0.199	144	1.14	0.94	1.38	0.199	144	1.14	0.83	1.58	0.423	102
***Wake-To-Work* [hours]**															
Any Back Pain [Yes/No]	0.95	0.85	1.06	0.388	146	0.96	0.86	1.07	0.452	146	0.86	0.70	1.06	0.153	114
Back Pain Radiating Past Knee [Yes/No]	1.01	0.89	1.15	0.825	146	1.02	0.89	1.15	0.819	146	0.86	0.66	1.14	0.293	114
Average Pain Severity [NRS 0-10]	-0.06	-0.22	0.09	0.397	144	-0.06	-0.21	0.09	0.455	144	-0.17	-0.40	0.07	0.157	114
Average Pain Severity [High/Low]	0.94	0.84	1.06	0.337	144	0.95	0.84	1.07	0.415	144	0.82	0.64	1.05	0.120	114
Average Pain Severity [reference: None]					144					144					114
Mild-Moderate	0.96	0.83	1.10	0.534		0.96	0.84	1.10	0.572		0.90	0.71	1.15	0.404	
Severe	0.92	0.79	1.08	0.311		0.93	0.80	1.10	0.404		0.81	0.59	1.10	0.180	
Very Severe	0.94	0.79	1.12	0.474		0.93	0.78	1.12	0.464		0.69	0.46	1.02	0.065	
Worst Pain Severity [NRS 0-10]	-0.15	-0.32	0.03	0.105	144	-0.13	-0.31	0.04	0.136	144	-0.28	-0.55	0.00	0.049	114
Current Pain Severity [NRS 0-10]	-0.01	-0.13	0.11	0.874	144	-0.01	-0.12	0.11	0.919	144	0.00	-0.17	0.18	0.965	114
Total Days with Back Pain	-0.34	-2.26	1.58	0.725	141	-0.32	-2.25	1.61	0.744	141	0.85	-2.10	3.80	0.570	111
Total Days with Back Pain [reference: No back pain]					141					141					111
1-7 Days	0.94	0.83	1.08	0.392		0.95	0.83	1.09	0.494		0.76	0.60	0.98	0.031	
8-180 Days	0.93	0.79	1.09	0.345		0.92	0.79	1.09	0.342		0.96	0.72	1.29	0.790	
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.99	0.87	1.12	0.842		1.00	0.88	1.14	0.980		0.86	0.69	1.08	0.194	
6 to 12 weeks	1.12	0.85	1.47	0.420		1.13	0.86	1.49	0.393		1.39	0.85	2.26	0.187	
12 weeks or longer	0.82	0.63	1.08	0.163		0.82	0.62	1.08	0.156			‡			
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.99	0.87	1.12	0.843		1.00	0.88	1.14	0.996		0.88	0.70	1.09	0.238	
6 weeks or longer	0.96	0.80	1.16	0.667		0.96	0.80	1.16	0.688		1.19	0.82	1.73	0.368	
Medication for Back Pain [Yes/No]	0.99	0.88	1.11	0.832	144	0.99	0.88	1.11	0.845	144	0.83	0.67	1.03	0.084	112
Health Care Provider Visit [Yes/No]	0.95	0.80	1.12	0.520	144	0.94	0.79	1.12	0.508	144	0.83	0.63	1.11	0.211	112
Activitiy Limitations [Yes/No]	0.97	0.86	1.10	0.630	143	0.98	0.86	1.11	0.713	143	0.94	0.77	1.16	0.578	111
At Least One Day Away from Work Due to Back Pain [Yes/No]	1.00	0.84	1.18	0.968	144	1.00	0.84	1.19	0.979	144	0.85	0.63	1.16	0.305	102

Table 8-3a (Cont.). Association between wake time duration before work and 6-month prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
***Wake-To-Leave≤2Hrs* [Yes/No]**															
Any Back Pain [Yes/No]	1.04	0.50	2.13	0.924	146	1.00	0.48	2.08	0.997	146	2.19	0.46	10.39	0.322	114
Back Pain Radiating Past Knee [Yes/No]	0.83	0.35	1.96	0.664	146	0.82	0.35	1.94	0.652	146	2.52	0.37	16.96	0.343	114
Average Pain Severity [NRS 0-10]	-0.20	-1.20	0.79	0.686	144	-0.24	-1.23	0.76	0.636	144	-0.10	-1.83	1.62	0.905	114
Average Pain Severity [High/Low]	0.81	0.36	1.82	0.616	144	0.77	0.34	1.76	0.538	144	1.16	0.22	6.18	0.860	114
Average Pain Severity [reference: None]					144					144					114
Mild-Moderate	1.34	0.56	3.20	0.516		1.30	0.54	3.15	0.556		1.62	0.31	8.62	0.569	
Severe	1.01	0.36	2.80	0.987		0.94	0.32	2.73	0.905		1.41	0.16	12.13	0.753	
Very Severe	0.75	0.22	2.59	0.654		0.76	0.22	2.63	0.664		2.18	0.13	35.37	0.584	
Worst Pain Severity [NRS 0-10]	0.46	-0.72	1.63	0.445	144	0.40	-0.77	1.56	0.501	144	1.02	-1.03	3.06	0.327	114
Current Pain Severity [NRS 0-10]	-0.36	-1.12	0.40	0.349	144	-0.37	-1.14	0.39	0.335	144	-1.01	-2.29	0.28	0.124	114
Total Days with Back Pain	4.25	-8.25	16.74	0.503	141	4.33	-8.21	16.87	0.495	141	-6.10	-27.54	15.34	0.574	111
Total Days with Back Pain [reference: No back pain]					141					141					111
1-7 Days	0.96	0.40	2.29	0.927		0.89	0.36	2.19	0.799		2.05	0.40	10.47	0.390	
8-180 Days	1.48	0.55	4.00	0.443		1.48	0.55	4.03	0.439		0.73	0.08	7.01	0.783	
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.69	0.29	1.63	0.394		0.61	0.25	1.51	0.289		0.66	0.14	3.15	0.603	
6 to 12 weeks	0.91	0.17	5.00	0.918		0.90	0.16	5.01	0.901		0.12	0.00	8.18	0.328	
12 weeks or longer	3.05	0.64	14.52	0.162		3.07	0.64	14.74	0.161			‡			
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.69	0.29	1.63	0.394		0.62	0.25	1.52	0.295		0.61	0.13	2.95	0.542	
6 weeks or longer	1.71	0.54	5.40	0.357		1.69	0.53	5.35	0.374		0.28	0.01	5.68	0.404	
Medication for Back Pain [Yes/No]	0.80	0.36	1.76	0.578	144	0.80	0.36	1.76	0.576	144	1.36	0.30	6.07	0.690	112
Health Care Provider Visit [Yes/No]	1.38	0.47	4.01	0.555	144	1.42	0.48	4.21	0.522	144	3.37	0.58	19.45	0.175	112
Activitiy Limitations [Yes/No]	1.60	0.73	3.53	0.240	143	1.56	0.70	3.46	0.274	143	3.61	0.79	16.58	0.099	111
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.72	0.22	2.35	0.587	144	0.73	0.22	2.42	0.601	144	0.83	0.10	6.77	0.863	102
***Wake-To-Work≤2Hrs* [Yes/No]**															
Any Back Pain [Yes/No]	1.03	0.46	2.30	0.946	146	0.96	0.42	2.19	0.931	146	1.38	0.22	8.61	0.728	114
Back Pain Radiating Past Knee [Yes/No]	0.95	0.37	2.45	0.916	146	0.93	0.36	2.42	0.886	146	8.14	0.54	123.95	0.131	114
Average Pain Severity [NRS 0-10]	0.23	-0.87	1.34	0.677	144	0.16	-0.95	1.27	0.776	144	1.53	-0.48	3.54	0.134	114
Average Pain Severity [High/Low]	1.26	0.53	2.97	0.598	144	1.15	0.48	2.78	0.754	144	5.89	0.46	75.29	0.173	114
Average Pain Severity [reference: None]					144					144					114
Mild-Moderate	1.02	0.37	2.82	0.972		0.96	0.34	2.69	0.937		0.39	0.04	3.74	0.412	
Severe	1.31	0.44	3.91	0.629		1.09	0.34	3.43	0.886		2.25	0.12	41.38	0.584	
Very Severe	1.21	0.34	4.28	0.769		1.25	0.35	4.53	0.729			‡			
Worst Pain Severity [NRS 0-10]	0.57	-0.74	1.88	0.389	144	0.45	-0.86	1.75	0.500	144	1.57	-0.83	3.96	0.197	114
Current Pain Severity [NRS 0-10]	0.17	-0.67	1.02	0.688	144	0.16	-0.70	1.01	0.719	144	1.05	-0.46	2.57	0.171	114
Total Days with Back Pain	3.30	-10.61	17.20	0.640	141	3.95	-10.06	17.97	0.578	141	14.13	-10.98	39.25	0.267	111
Total Days with Back Pain [reference: No back pain]					141					141					111
1-7 Days	0.77	0.28	2.14	0.616		0.63	0.22	1.84	0.398		1.14	0.14	9.16	0.905	
8-180 Days	1.86	0.65	5.30	0.244		1.91	0.66	5.53	0.230		10.03	0.50	203.00	0.133	
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.99	0.39	2.50	0.986		0.84	0.32	2.20	0.720		3.36	0.30	37.06	0.323	
6 to 12 weeks	0.64	0.07	5.64	0.688		0.64	0.07	5.90	0.695		0.19	0.01	6.59	0.358	
12 weeks or longer	2.88	0.59	13.99	0.189		2.82	0.58	13.78	0.201			‡			
Longest Episode of Back Pain [reference: No back pain]					145					145					113
Up to 6 weeks	0.99	0.39	2.50	0.986		0.85	0.32	2.22	0.733		2.40	0.27	21.08	0.431	
6 weeks or longer	1.54	0.43	5.44	0.505		1.52	0.42	5.46	0.525		0.70	0.03	14.12	0.814	
Medication for Back Pain [Yes/No]	0.73	0.30	1.79	0.487	144	0.73	0.29	1.80	0.491	144	1.95	0.27	14.10	0.506	112
Health Care Provider Visit [Yes/No]	0.47	0.10	2.19	0.337	144	0.49	0.10	2.33	0.371	144	0.88	0.07	10.67	0.923	112
Activitiy Limitations [Yes/No]	1.24	0.51	3.02	0.633	143	1.16	0.47	2.87	0.743	143	2.42	0.34	17.29	0.379	111
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.79	0.21	2.96	0.731	144	0.84	0.22	3.27	0.801	144	5.55	0.28	112.09	0.263	102

† - Effect sizes for dichotomous outcome variables are odds ratios; for continuous variables (Numeric rating scale, and Total Days with Back Pain) effect sizes are the linear regression coefficient; and for outcome variables with more than two ordinal levels the effect sizes are given as the relative risk ratio.
‡ - Sample size within cell (Exposure/Outcome combination) too small.

Table 8-3b. Association between activity within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
***Activity w/in 2hrs of Waking* [reference: None]**															
Any Back Pain [Yes/No]					141					141					117
Minimal	1.08	0.43	2.70	0.865	32	1.11	0.44	2.78	0.828	32	1.85	0.59	5.81	0.291	29
Moderate	0.74	0.31	1.80	0.507	34	0.69	0.28	1.72	0.429	34	0.92	0.28	3.06	0.898	29
Considerable	1.93	0.59	6.28	0.277	18	1.85	0.56	6.11	0.310	18	1.97	0.48	8.04	0.343	17
Nearly All the Time	1.73	0.40	7.52	0.466	10	1.58	0.36	6.96	0.546	10	2.12	0.24	18.57	0.498	7
Back Pain Radiating Past Knee [Yes/No]					141					141					117
Minimal	0.60	0.20	1.80	0.366	32	0.60	0.20	1.79	0.357	32	1.06	0.23	4.89	0.943	29
Moderate	0.56	0.19	1.67	0.297	34	0.57	0.19	1.71	0.314	34	0.73	0.15	3.50	0.693	29
Considerable	2.09	0.68	6.47	0.200	18	2.19	0.70	6.85	0.178	18	2.58	0.49	13.58	0.262	17
Nearly All the Time	1.12	0.25	5.00	0.881	10	1.18	0.26	5.33	0.830	10	2.06	0.11	39.65	0.631	7
Average Pain Severity [NRS 0-10]					140					140					117
Minimal	-0.07	-1.29	1.16	0.916	32	-0.03	-1.26	1.19	0.958	32	0.39	-0.92	1.69	0.559	29
Moderate	-0.59	-1.80	0.61	0.330	34	-0.70	-1.92	0.52	0.260	34	-0.92	-2.30	0.47	0.194	29
Considerable	2.21	0.73	3.69	0.004	18	2.23	0.74	3.72	0.004	18	2.05	0.45	3.65	0.012	17
Nearly All the Time	1.33	-0.52	3.19	0.157	10	1.25	-0.62	3.12	0.188	10	1.32	-1.08	3.72	0.277	7
Average Pain Severity [High/Low]					140					140					117
Minimal	0.85	0.30	2.36	0.750	32	0.88	0.31	2.52	0.814	32	1.55	0.33	7.20	0.578	29
Moderate	0.34	0.10	1.15	0.083	34	0.28	0.08	0.98	0.046	34	0.20	0.03	1.16	0.072	29
Considerable	3.99	1.27	12.53	0.018	18	4.28	1.31	13.96	0.016	18	9.03	1.57	51.89	0.014	17
Nearly All the Time	2.54	0.63	10.25	0.191	10	2.27	0.55	9.37	0.258	10	3.82	0.24	59.85	0.340	7
Average Pain Severity [reference: None]					140					140					117
Minimal					32					32					29
Mild-Moderate	1.15	0.37	3.55	0.808		1.18	0.38	3.65	0.779		1.31	0.36	4.86	0.683	
Severe	0.90	0.25	3.25	0.870		0.97	0.25	3.81	0.968		1.23	0.16	9.33	0.839	
Very Severe	0.86	0.18	4.13	0.853		0.86	0.18	4.13	0.851		1.81	0.20	16.50	0.599	
Moderate					34					34					29
Mild-Moderate	1.15	0.40	3.33	0.796		1.05	0.36	3.12	0.927		1.22	0.30	5.04	0.780	
Severe	0.29	0.05	1.51	0.141		0.19	0.03	1.09	0.062		0.06	0.00	0.97	0.048	
Very Severe	0.46	0.08	2.64	0.383		0.46	0.08	2.72	0.396		0.59	0.06	5.84	0.649	
Considerable					18					18					17
Mild-Moderate	0.92	0.15	5.57	0.928		0.93	0.15	5.66	0.935		0.69	0.09	5.02	0.710	
Severe	2.87	0.66	12.60	0.161		3.23	0.67	15.63	0.145		5.28	0.57	48.59	0.142	
Very Severe	5.52	1.19	25.52	0.029		5.42	1.16	25.39	0.032		13.37	1.20	148.29	0.035	
Nearly All the Time					10					10					7
Mild-Moderate	1.53	0.22	10.64	0.665		1.43	0.20	10.00	0.721		1.78	0.14	22.81	0.657	
Severe	2.88	0.48	17.24	0.248		2.48	0.39	15.77	0.337		1.78	0.06	55.81	0.744	
Very Severe	3.07	0.40	23.44	0.280		3.06	0.39	23.82	0.285		46.56	0.67	3248.91	0.076	
Worst Pain Severity [NRS 0-10]					140					140					117
Minimal	0.20	-1.25	1.64	0.789	32	0.25	-1.18	1.69	0.728	32	0.36	-1.18	1.91	0.641	29
Moderate	-0.39	-1.81	1.02	0.585	34	-0.58	-2.00	0.85	0.425	34	-1.34	-2.98	0.30	0.108	29
Considerable	2.25	0.51	3.99	0.012	18	2.26	0.52	4.00	0.012	18	1.74	-0.15	3.63	0.070	17
Nearly All the Time	2.10	-0.09	4.28	0.060	10	1.93	-0.26	4.12	0.083	10	1.30	-1.53	4.14	0.363	7
Current Pain Severity [NRS 0-10]					140					140					117
Minimal	-0.43	-1.34	0.47	0.345	32	-0.42	-1.33	0.49	0.362	32	-0.25	-1.20	0.70	0.602	29
Moderate	-0.74	-1.63	0.15	0.101	34	-0.78	-1.68	0.12	0.090	34	-0.89	-1.91	0.12	0.083	29
Considerable	0.63	-0.47	1.72	0.259	18	0.65	-0.46	1.75	0.248	18	0.29	-0.87	1.46	0.620	17
Nearly All the Time	1.45	0.08	2.82	0.038	10	1.43	0.04	2.81	0.043	10	0.84	-0.91	2.59	0.345	7
Total Days with Back Pain					137					137					115
Minimal	5.66	-10.86	22.19	0.499	31	5.40	-11.20	22.00	0.521	31	6.98	-9.76	23.73	0.410	28
Moderate	5.54	-10.55	21.64	0.497	34	6.57	-9.74	22.88	0.427	34	10.20	-7.27	27.67	0.249	29
Considerable	14.01	-5.71	33.73	0.162	18	13.19	-6.74	33.12	0.193	18	6.72	-13.48	26.92	0.511	17
Nearly All the Time	49.55	24.86	74.25	0.000	10	49.92	25.02	74.83	0.000	10	39.30	8.96	69.64	0.012	7

Table 8-3b (Cont.). Association between activity within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
Activity w/in 2hrs of Waking* [reference: None] *(cont.)															
Total Days with Back Pain [reference: No back pain]					137					137					115
Minimal					31					31					28
1-7 Days	1.44	0.50	4.18	0.498		1.52	0.50	4.62	0.463		1.55	0.39	6.11	0.533	
8-180 Days	2.94	0.62	13.86	0.173		2.89	0.61	13.66	0.181		3.14	0.48	20.47	0.232	
Moderate					34					34					29
1-7 Days	0.57	0.17	1.86	0.350		0.44	0.13	1.53	0.198		0.32	0.07	1.46	0.143	
8-180 Days	2.08	0.45	9.61	0.347		2.29	0.48	10.84	0.296		1.90	0.29	12.51	0.503	
Considerable					18					18					17
1-7 Days	2.73	0.78	9.57	0.117		2.82	0.76	10.50	0.123		2.04	0.43	9.72	0.368	
8-180 Days	5.71	1.04	31.53	0.046		5.80	1.04	32.47	0.046		2.75	0.31	24.64	0.367	
Nearly All the Time					10					10					7
1-7 Days	1.82	0.27	12.38	0.541		1.46	0.21	10.29	0.705		1.52	0.13	18.11	0.742	
8-180 Days	16.67	2.60	107.00	0.003		18.85	2.82	125.81	0.002		10.75	0.56	207.80	0.116	
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Minimal					32					32					29
Up to 6 weeks	1.79	0.61	5.28	0.291		1.97	0.64	6.06	0.235		2.22	0.55	8.96	0.262	
6 to 12 weeks	1.79	0.23	13.75	0.576		1.79	0.23	13.83	0.578		0.68	0.06	7.97	0.759	
12 weeks or longer	3.58	0.30	42.09	0.311		3.89	0.32	46.95	0.286				‡		
Moderate															29
Up to 6 weeks	1.10	0.36	3.37	0.865	34	0.89	0.28	2.83	0.837	34	0.61	0.15	2.56	0.503	
6 to 12 weeks	2.13	0.33	13.70	0.428		2.18	0.33	14.38	0.418		1.12	0.12	10.14	0.919	
12 weeks or longer			‡					‡					‡		
Considerable					18					18					
Up to 6 weeks	4.86	1.42	16.63	0.012		5.49	1.52	19.87	0.010		5.02	1.00	25.24	0.050	17
6 to 12 weeks	2.43	0.19	30.62	0.493		2.16	0.17	27.92	0.556		0.98	0.05	17.68	0.989	
12 weeks or longer	4.86	0.27	87.24	0.284		6.05	0.32	113.42	0.229				‡		
Nearly All the Time					10					10					7
Up to 6 weeks	5.04	0.95	26.70	0.057		4.53	0.83	24.87	0.082		9.07	0.76	108.03	0.081	
6 to 12 weeks			‡					‡					‡		
12 weeks or longer	33.99	2.65	436.41	0.007		38.77	2.81	535.15	0.006				‡		
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Minimal					32					32					29
Up to 6 weeks	1.79	0.61	5.28	0.291		1.96	0.64	6.03	0.238		1.87	0.48	7.33	0.366	
6 weeks or longer	2.39	0.48	11.80	0.286		2.39	0.48	11.88	0.286		1.81	0.23	14.15	0.573	
Moderate					34					34					29
Up to 6 weeks	1.10	0.36	3.37	0.865		0.90	0.28	2.86	0.852		0.61	0.15	2.49	0.489	
6 weeks or longer	1.42	0.26	7.63	0.685		1.41	0.26	7.70	0.695		1.14	0.13	9.90	0.903	
Considerable					18					18					17
Up to 6 weeks	4.86	1.42	16.63	0.012		5.45	1.51	19.70	0.010		4.68	0.96	22.92	0.057	
6 weeks or longer	3.24	0.45	23.11	0.241		3.29	0.45	23.78	0.239		0.87	0.05	15.89	0.926	
Nearly All the Time					10					10					7
Up to 6 weeks	5.04	0.95	26.69	0.057		4.49	0.82	24.49	0.083		6.88	0.60	78.42	0.120	
6 weeks or longer	11.33	1.55	82.79	0.017		11.35	1.53	84.14	0.017		0.94	0.02	53.87	0.978	
Medication for Back Pain [Yes/No]					139					139					115
Minimal	1.96	0.73	5.25	0.179	32	1.95	0.73	5.23	0.184	32	1.46	0.43	4.96	0.545	29
Moderate	1.57	0.58	4.20	0.373	34	1.65	0.61	4.49	0.326	34	1.09	0.31	3.80	0.887	29
Considerable	3.27	1.00	10.76	0.051	16	3.26	0.99	10.75	0.053	16	2.16	0.48	9.68	0.315	15
Nearly All the Time	3.27	0.80	13.43	0.100	10	3.37	0.81	13.99	0.094	10	2.19	0.28	16.99	0.452	7
Health Care Provider Visit [Yes/No]					139					139					115
Minimal	10.62	1.21	93.06	0.033	32	11.24	1.27	99.75	0.030	32	8.72	0.80	94.86	0.075	29
Moderate	7.93	0.88	71.35	0.065	34	8.54	0.93	78.38	0.058	34	4.21	0.37	47.74	0.246	29
Considerable	15.33	1.57	150.14	0.019	16	14.84	1.49	147.50	0.021	16	8.45	0.64	111.03	0.104	15
Nearly All the Time	5.11	0.29	89.46	0.264	10	4.93	0.28	88.24	0.278	10	8.11	0.29	226.42	0.218	7
Activitiy Limitations [Yes/No]					138					138					114
Minimal	1.92	0.68	5.44	0.220	32	1.98	0.69	5.67	0.202	32	1.52	0.42	5.53	0.528	29
Moderate	1.09	0.36	3.30	0.872	34	1.00	0.32	3.05	0.993	34	0.71	0.19	2.74	0.623	29
Considerable	2.81	0.80	9.95	0.108	15	2.86	0.80	10.25	0.106	15	1.65	0.33	8.29	0.540	14
Nearly All the Time	4.22	1.00	17.76	0.049	10	3.91	0.92	16.63	0.065	10	3.49	0.40	30.28	0.256	7
At Least One Day Away from Work Due to Back Pain [Yes/No]					139					139					104
Minimal	0.38	0.07	1.97	0.249	32	0.39	0.07	2.03	0.262	32	0.48	0.07	3.16	0.442	26
Moderate	0.99	0.28	3.42	0.981	34	1.01	0.28	3.64	0.986	34	1.49	0.30	7.51	0.626	26
Considerable	0.82	0.15	4.40	0.813	16	0.73	0.13	4.07	0.720	16	0.28	0.02	4.02	0.352	15
Nearly All the Time	0.63	0.07	5.83	0.688	10	0.57	0.06	5.41	0.623	10	1.23	0.08	19.82	0.886	3

Table 8-3b (Cont.). Association between activity within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
***Activity w/in 2hrs of Waking* [Low/High]**															
Any Back Pain [Yes/No]	1.98	0.81	4.88	0.136	141	1.90	0.76	4.70	0.167	141	1.66	0.56	4.95	0.361	117
Back Pain Radiating Past Knee [Yes/No]	2.28	0.95	5.49	0.066	141	2.38	0.98	5.81	0.057	141	2.72	0.75	9.84	0.127	117
Average Pain Severity [NRS 0-10]	2.10	0.98	3.22	0.000	140	2.10	0.96	3.23	0.000	140	2.04	0.80	3.28	0.001	117
Average Pain Severity [High/Low]	4.64	1.94	11.08	0.001	140	4.74	1.94	11.58	0.001	140	10.69	2.75	41.55	0.001	117
Average Pain Severity [reference: None]					140					140					117
Mild-Moderate	1.05	0.29	3.80	0.936		1.05	0.29	3.82	0.938		0.78	0.18	3.40	0.746	
Severe	3.93	1.27	12.20	0.018		4.22	1.28	13.91	0.018		7.69	1.39	42.51	0.019	
Very Severe	5.90	1.80	19.34	0.003		5.80	1.75	19.24	0.004		16.91	2.47	115.59	0.004	
Worst Pain Severity [NRS 0-10]	2.26	0.95	3.57	0.001	140	2.24	0.92	3.56	0.001	140	1.96	0.49	3.43	0.009	117
Current Pain Severity [NRS 0-10]	1.27	0.44	2.10	0.003	140	1.28	0.44	2.13	0.003	140	0.84	-0.07	1.74	0.069	117
Total Days with Back Pain	23.36	8.21	38.52	0.003	137	22.82	7.45	38.19	0.004	137	8.70	-7.08	24.49	0.277	115
Total Days with Back Pain [reference: No back pain]					137					137					115
1-7 Days	2.56	0.93	7.01	0.068		2.51	0.88	7.11	0.084		2.36	0.71	7.82	0.161	
8-180 Days	4.92	1.67	14.44	0.004		5.05	1.69	15.07	0.004		2.02	0.44	9.30	0.367	
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Up to 6 weeks	4.00	1.56	10.25	0.004		4.24	1.59	11.27	0.004		4.87	1.43	16.56	0.011	
6 to 12 weeks	1.10	0.12	9.89	0.932		0.99	0.11	9.07	0.990		0.61	0.06	6.62	0.683	
12 weeks or longer	10.27	2.00	52.69	0.005		12.19	2.26	65.85	0.004		‡				
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Up to 6 weeks	4.00	1.56	10.25	0.004		4.21	1.59	11.15	0.004		4.75	1.40	16.07	0.012	
6 weeks or longer	3.85	1.09	13.57	0.036		3.91	1.10	13.97	0.036		0.63	0.07	5.47	0.674	
Medication for Back Pain [Yes/No]	2.32	0.98	5.53	0.057	139	2.31	0.97	5.53	0.060	139	1.81	0.59	5.58	0.299	115
Health Care Provider Visit [Yes/No]	2.00	0.64	6.29	0.234	139	1.87	0.59	5.97	0.290	139	1.88	0.44	8.12	0.396	115
Activitiy Limitations [Yes/No]	2.63	1.07	6.49	0.036	138	2.62	1.05	6.53	0.038	138	1.98	0.62	6.32	0.251	114
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.92	0.24	3.48	0.905	139	0.81	0.21	3.14	0.764	139	0.54	0.09	3.32	0.507	104
***Activity w/in 2hrs of Waking* [reference: None-Minimal]**															
Any Back Pain [Yes/No]					141					141					117
Moderate	0.72	0.32	1.61	0.420	34	0.67	0.29	1.53	0.339	34	0.68	0.24	1.94	0.466	29
Considerable-Nearly All the Time	1.79	0.70	4.56	0.220	28	1.68	0.65	4.32	0.281	28	1.45	0.45	4.61	0.533	24
Back Pain Radiating Past Knee [Yes/No]					141					141					117
Moderate	0.68	0.24	1.88	0.454	34	0.69	0.24	1.95	0.485	34	0.72	0.18	2.88	0.639	29
Considerable-Nearly All the Time	2.04	0.82	5.11	0.127	28	2.15	0.85	5.45	0.107	28	2.42	0.62	9.53	0.206	24
Average Pain Severity [NRS 0-10]					140					140					117
Moderate	-0.57	-1.65	0.52	0.303	34	-0.68	-1.78	0.43	0.229	34	-1.12	-2.31	0.08	0.068	29
Considerable-Nearly All the Time	1.93	0.76	3.09	0.001	28	1.89	0.72	3.07	0.002	28	1.65	0.36	2.95	0.013	24
Average Pain Severity [High/Low]					140					140					117
Moderate	0.36	0.11	1.15	0.085	34	0.29	0.09	0.97	0.044	34	0.16	0.03	0.75	0.020	29
Considerable-Nearly All the Time	3.62	1.47	8.90	0.005	28	3.56	1.41	8.96	0.007	28	5.93	1.45	24.30	0.013	24
Average Pain Severity [reference: None]					140					140					117
Moderate					34					34					29
Mild-Moderate	1.08	0.42	2.78	0.868		0.98	0.37	2.60	0.969		1.06	0.31	3.58	0.931	
Severe	0.30	0.06	1.46	0.136		0.19	0.04	1.02	0.053		0.06	0.01	0.70	0.024	
Very Severe	0.49	0.09	2.51	0.391		0.50	0.09	2.65	0.415		0.44	0.06	3.41	0.429	
Considerable-Nearly All the Time					28					28					24
Mild-Moderate	1.08	0.29	4.07	0.906		1.05	0.28	3.99	0.941		0.82	0.18	3.76	0.801	
Severe	3.00	0.94	9.61	0.064		2.94	0.86	10.06	0.085		3.42	0.58	20.13	0.173	
Very Severe	4.88	1.41	16.86	0.012		4.82	1.37	16.92	0.014		12.00	1.60	89.83	0.016	
Worst Pain Severity [NRS 0-10]					140					140					117
Moderate	-0.47	-1.75	0.81	0.466	34	-0.68	-1.97	0.62	0.303	34	-1.53	-2.94	-0.12	0.034	29
Considerable-Nearly All the Time	2.12	0.74	3.49	0.003	28	2.04	0.66	3.41	0.004	28	1.43	-0.10	2.95	0.066	24
Current Pain Severity [NRS 0-10]					140					140					117
Moderate	-0.56	-1.37	0.24	0.170	34	-0.62	-1.44	0.21	0.141	34	-0.76	-1.64	0.11	0.086	29
Considerable-Nearly All the Time	1.10	0.23	1.96	0.013	28	1.10	0.22	1.98	0.014	28	0.57	-0.37	1.52	0.234	24

Table 8-3b (Cont.). Association between activity within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**
Activity w/in 2hrs of Waking* [reference: None-Minimal] *(cont.)															
Total Days with Back Pain					137					137					115
Moderate	3.20	-11.63	18.03	0.670	34	4.09	-11.02	19.21	0.593	34	6.55	-8.87	21.97	0.402	29
Considerable-Nearly All the Time	24.36	8.47	40.25	0.003	28	24.08	7.98	40.18	0.004	28	10.96	-5.72	27.64	0.195	24
Total Days with Back Pain [reference: No back pain]					137					137					115
Moderate					34					34					29
1-7 Days	0.49	0.16	1.47	0.202		0.38	0.12	1.20	0.098		0.27	0.07	1.01	0.051	
8-180 Days	1.22	0.36	4.15	0.746		1.32	0.38	4.60	0.668		1.02	0.23	4.57	0.979	
Considerable-Nearly All the Time					28					28					24
1-7 Days	2.12	0.75	5.99	0.159		1.93	0.66	5.69	0.232		1.52	0.43	5.44	0.516	
8-180 Days	5.29	1.64	17.07	0.005		5.57	1.69	18.35	0.005		2.05	0.40	10.59	0.393	
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Moderate					34					34					29
Up to 6 weeks	0.86	0.32	2.33	0.765		0.67	0.23	1.91	0.451		0.41	0.12	1.39	0.151	
6 to 12 weeks	1.66	0.34	7.98	0.529		1.73	0.35	8.61	0.506		1.39	0.22	8.66	0.725	
12 weeks or longer			‡					‡					‡		
Considerable-Nearly All the Time					28					28					24
Up to 6 weeks	3.83	1.43	10.23	0.007		3.82	1.38	10.57	0.010		3.60	0.99	13.13	0.052	
6 to 12 weeks	1.32	0.13	13.13	0.810		1.20	0.12	12.15	0.879		0.70	0.06	8.48	0.780	
12 weeks or longer	7.07	1.37	36.52	0.020		8.15	1.51	43.92	0.015				‡		
Longest Episode of Back Pain [reference: No back pain]					140					140					116
Moderate					34					34					29
Up to 6 weeks	0.86	0.32	2.33	0.765		0.68	0.24	1.93	0.468		0.44	0.13	1.48	0.184	
6 weeks or longer	0.95	0.23	3.98	0.940		0.93	0.21	4.00	0.917		0.83	0.14	4.71	0.829	
Considerable-Nearly All the Time					28					28					24
Up to 6 weeks	3.83	1.43	10.23	0.007		3.78	1.37	10.41	0.010		3.58	0.99	13.00	0.052	
6 weeks or longer	3.79	1.00	14.34	0.050		3.83	1.00	14.67	0.050		0.60	0.06	5.64	0.653	
Medication for Back Pain [Yes/No]					139					139					115
Moderate	1.16	0.49	2.77	0.731	34	1.24	0.51	2.99	0.640	34	0.90	0.31	2.59	0.842	29
Considerable-Nearly All the Time	2.43	0.98	6.04	0.055	26	2.47	0.99	6.18	0.054	26	1.75	0.53	5.71	0.357	22
Health Care Provider Visit [Yes/No]					139					139					115
Moderate	1.77	0.52	6.04	0.360	34	1.88	0.54	6.59	0.324	34	1.02	0.23	4.61	0.979	29
Considerable-Nearly All the Time	2.45	0.70	8.52	0.159	26	2.33	0.66	8.28	0.190	26	1.90	0.39	9.17	0.425	22
Activitiy Limitations [Yes/No]					138					138					114
Moderate	0.82	0.31	2.18	0.689	34	0.74	0.27	2.00	0.548	34	0.57	0.18	1.77	0.332	29
Considerable-Nearly All the Time	2.48	0.97	6.37	0.059	25	2.40	0.93	6.22	0.071	25	1.60	0.47	5.52	0.455	21
At Least One Day Away from Work Due to Back Pain [Yes/No]					139					139					104
Moderate	1.34	0.41	4.35	0.625	34	1.37	0.41	4.60	0.609	34	2.01	0.47	8.58	0.346	26
Considerable-Nearly All the Time	1.01	0.25	4.07	0.984	26	0.90	0.22	3.72	0.886	26	0.68	0.10	4.58	0.693	18

† - Effect sizes for dichotomous outcome variables are odds ratios; for continuous variables (Numeric rating scale, and Total Days with Back Pain) effect sizes are the linear regression coefficient; and for outcome variables with more than two ordinal levels the effect sizes are given as the relative risk ratio.
‡ - Sample size within cell (Exposure/Outcome combination) too small.

Table 8-3c. Association between exercise (home or UCLA) and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**
***Exericse at Home within 2hrs of waking* [Yes/No]**															
Any Back Pain [Yes/No]	0.61	0.32	1.17	0.138	150	0.63	0.32	1.23	0.175	150	0.70	0.32	1.53	0.366	122
Back Pain Radiating Past Knee [Yes/No]	0.93	0.44	1.96	0.850	150	0.91	0.43	1.93	0.807	150	1.10	0.40	3.02	0.855	122
Average Pain Severity [NRS 0-10]	-0.86	-1.76	0.03	0.059	149	-0.81	-1.72	0.10	0.081	149	-0.33	-1.28	0.63	0.502	122
Average Pain Severity [High/Low]	0.54	0.26	1.11	0.095	149	0.59	0.28	1.23	0.156	149	0.82	0.32	2.14	0.692	122
Average Pain Severity [reference: None]					149					149					122
Mild-Moderate	0.63	0.28	1.44	0.278		0.67	0.29	1.54	0.347		0.70	0.28	1.76	0.442	
Severe	0.60	0.24	1.53	0.288		0.76	0.29	2.02	0.583		0.77	0.22	2.74	0.685	
Very Severe	0.33	0.11	0.97	0.043		0.31	0.10	0.92	0.035		0.57	0.13	2.44	0.451	
Worst Pain Severity [NRS 0-10]	-0.69	-1.74	0.36	0.194	149	-0.56	-1.62	0.50	0.298	149	-0.15	-1.28	0.97	0.789	122
Current Pain Severity [NRS 0-10]	-0.38	-1.04	0.29	0.267	149	-0.36	-1.04	0.32	0.296	149	-0.05	-0.73	0.64	0.897	122
Total Days with Back Pain	4.82	-7.11	16.75	0.426	145	4.40	-7.75	16.56	0.475	145	7.79	-3.89	19.47	0.189	119
Total Days with Back Pain [reference: No back pain]					145					145					119
1-7 Days	0.34	0.15	0.78	0.011		0.38	0.16	0.88	0.024		0.50	0.19	1.32	0.164	
8-180 Days	0.93	0.36	2.38	0.881		0.91	0.35	2.34	0.838		1.16	0.35	3.79	0.808	
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.48	0.23	1.03	0.061		0.54	0.25	1.18	0.123		0.71	0.29	1.73	0.454	
6 to 12 weeks	0.81	0.19	3.42	0.772		0.80	0.19	3.43	0.763		1.03	0.21	5.16	0.972	
12 weeks or longer	0.61	0.13	2.86	0.527		0.63	0.13	3.02	0.562			‡			
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.48	0.23	1.03	0.061		0.54	0.25	1.18	0.122		0.74	0.31	1.79	0.509	
6 weeks or longer	0.71	0.24	2.11	0.534		0.71	0.24	2.14	0.545		0.63	0.15	2.64	0.528	
Medication for Back Pain [Yes/No]	0.89	0.45	1.75	0.728	148	0.86	0.43	1.71	0.662	148	0.86	0.37	1.99	0.721	120
Health Care Provider Visit [Yes/No]	1.29	0.48	3.47	0.616	148	1.28	0.46	3.53	0.635	148	1.07	0.32	3.59	0.907	120
Activitiy Limitations [Yes/No]	0.60	0.29	1.26	0.177	147	0.63	0.30	1.34	0.234	147	0.74	0.31	1.78	0.497	119
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.46	0.16	1.29	0.138	148	0.43	0.15	1.26	0.125	148	0.39	0.10	1.51	0.171	109
***Exercise at UCLA "Warm up for work"* [Yes/No]**															
Any Back Pain [Yes/No]	1.17	0.61	2.25	0.632	150	1.37	0.69	2.72	0.362	150	1.20	0.53	2.70	0.665	122
Back Pain Radiating Past Knee [Yes/No]	0.84	0.40	1.76	0.641	150	0.81	0.37	1.74	0.584	150	1.11	0.40	3.08	0.847	122
Average Pain Severity [NRS 0-10]	-0.27	-1.18	0.64	0.556	149	-0.14	-1.08	0.80	0.770	149	-0.21	-1.19	0.78	0.677	122
Average Pain Severity [High/Low]	0.70	0.35	1.43	0.334	149	0.82	0.39	1.71	0.596	149	0.57	0.21	1.51	0.257	122
Average Pain Severity [reference: None]					149					149					122
Mild-Moderate	1.87	0.80	4.40	0.151		2.17	0.89	5.29	0.087		1.70	0.65	4.45	0.282	
Severe	0.89	0.36	2.25	0.814		1.26	0.47	3.39	0.641		0.44	0.11	1.72	0.237	
Very Severe	0.81	0.29	2.22	0.675		0.85	0.30	2.45	0.764		0.90	0.22	3.74	0.889	
Worst Pain Severity [NRS 0-10]	-0.37	-1.43	0.69	0.493	149	-0.13	-1.22	0.95	0.808	149	-0.26	-1.42	0.89	0.654	122
Current Pain Severity [NRS 0-10]	-0.07	-0.74	0.61	0.843	149	0.00	-0.70	0.70	1.000	149	0.01	-0.70	0.72	0.982	122
Total Days with Back Pain	5.26	-6.72	17.23	0.387	145	5.93	-6.40	18.25	0.343	145	10.35	-1.56	22.27	0.088	119
Total Days with Back Pain [reference: No back pain]					145					145					119
1-7 Days	0.91	0.42	1.98	0.808		1.17	0.51	2.65	0.710		1.10	0.42	2.87	0.841	
8-180 Days	0.97	0.38	2.49	0.958		0.96	0.36	2.54	0.939		1.13	0.34	3.79	0.840	
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.49	0.23	1.05	0.066		0.60	0.27	1.31	0.199		0.57	0.23	1.42	0.229	
6 to 12 weeks	2.22	0.43	11.59	0.343		2.66	0.49	14.57	0.258		3.08	0.47	20.38	0.243	
12 weeks or longer	1.85	0.34	10.04	0.475		1.88	0.33	10.62	0.473			‡			
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.49	0.23	1.05	0.066		0.60	0.27	1.31	0.199		0.57	0.23	1.42	0.230	
6 weeks or longer	2.04	0.60	6.87	0.251		2.21	0.64	7.65	0.212		3.37	0.61	18.71	0.165	
Medication for Back Pain [Yes/No]	1.04	0.52	2.06	0.917	148	1.06	0.52	2.15	0.876	148	0.84	0.35	1.97	0.681	120
Health Care Provider Visit [Yes/No]	0.61	0.22	1.63	0.322	148	0.68	0.24	1.91	0.468	148	0.60	0.18	2.06	0.420	120
Activitiy Limitations [Yes/No]	0.53	0.25	1.11	0.094	147	0.59	0.28	1.27	0.179	147	0.48	0.19	1.20	0.116	119
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.61	0.22	1.63	0.322	148	0.73	0.26	2.04	0.547	148	0.74	0.20	2.68	0.645	109

Table 8-3c (Cont.). Association between exercise (home or UCLA) and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure *Outcome* **Exposure Level** Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
***Exercise at UCLA "Warm up for work" within 2hrs waking* [Yes/No]**															
Any Back Pain [Yes/No]	0.55	0.18	1.67	0.289	149	0.61	0.20	1.88	0.386	149	0.62	0.12	3.20	0.570	119
Back Pain Radiating Past Knee [Yes/No]	0.88	0.23	3.34	0.849	149	0.88	0.23	3.41	0.859	149	1.45	0.18	11.51	0.727	119
Average Pain Severity [NRS 0-10]	-0.99	-2.51	0.53	0.200	147	-0.90	-2.44	0.64	0.251	147	-0.77	-2.72	1.17	0.431	119
Average Pain Severity [High/Low]	0.40	0.09	1.88	0.247	147	0.44	0.09	2.11	0.307	147	0.15	0.01	2.13	0.162	119
Average Pain Severity [reference: None]					147					147					119
Mild-Moderate	1.12	0.31	4.02	0.861		1.21	0.33	4.45	0.773		1.05	0.18	6.15	0.960	
Severe	0.74	0.15	3.74	0.714		0.92	0.17	5.00	0.927		0.23	0.01	4.37	0.331	
Very Severe		‡					‡					‡			
Worst Pain Severity [NRS 0-10]	-0.83	-2.63	0.97	0.365	147	-0.66	-2.47	1.15	0.473	147	-0.66	-2.96	1.65	0.573	119
Current Pain Severity [NRS 0-10]	-0.17	-1.29	0.95	0.761	147	-0.13	-1.27	1.01	0.821	147	0.44	-0.99	1.86	0.544	119
Total Days with Back Pain	-6.82	-25.38	11.74	0.469	144	-6.59	-25.38	12.20	0.489	144	-1.97	-25.89	21.95	0.871	116
Total Days with Back Pain [reference: No back pain]					144					144					116
1-7 Days	0.46	0.10	2.21	0.331		0.54	0.11	2.70	0.449		0.63	0.08	4.91	0.658	
8-180 Days	0.87	0.17	4.30	0.861		0.86	0.17	4.32	0.850		0.47	0.03	7.97	0.605	
Longest Episode of Back Pain [reference: No back pain]					148					148					118
Up to 6 weeks	0.20	0.02	1.57	0.125		0.22	0.03	1.79	0.156		0.16	0.01	1.90	0.147	
6 to 12 weeks	1.27	0.14	11.58	0.831		1.59	0.16	15.35	0.691		1.31	0.05	33.67	0.870	
12 weeks or longer	1.53	0.16	14.30	0.711		1.38	0.14	13.26	0.778			‡			
Longest Episode of Back Pain [reference: No back pain]					148					148					118
Up to 6 weeks	0.20	0.02	1.57	0.125		0.22	0.03	1.79	0.156		0.17	0.01	1.94	0.153	
6 weeks or longer	1.39	0.27	7.10	0.694		1.43	0.27	7.46	0.670		1.25	0.06	26.32	0.887	
Medication for Back Pain [Yes/No]	0.53	0.14	2.01	0.353	147	0.56	0.15	2.14	0.398	147	0.56	0.08	4.14	0.569	117
Health Care Provider Visit [Yes/No]		‡			133		‡			133		‡			105
Activitiy Limitations [Yes/No]		‡			132		‡			132		‡			104
At Least One Day Away from Work Due to Back Pain [Yes/No]		‡			133		‡			133		‡			96
***Exercise home within 2hrs waking or UCLA "Warm up for work"* [Yes/No]**															
Any Back Pain [Yes/No]	0.73	0.35	1.54	0.411	150	0.79	0.37	1.67	0.532	150	0.80	0.33	1.99	0.637	122
Back Pain Radiating Past Knee [Yes/No]	0.61	0.27	1.35	0.222	150	0.58	0.26	1.31	0.193	150	0.88	0.31	2.51	0.817	122
Average Pain Severity [NRS 0-10]	-1.07	-2.08	-0.06	0.038	149	-1.00	-2.03	0.03	0.057	149	-0.79	-1.87	0.28	0.146	122
Average Pain Severity [High/Low]	0.42	0.20	0.91	0.028	149	0.47	0.21	1.03	0.059	149	0.46	0.17	1.23	0.121	122
Average Pain Severity [reference: None]					149					149					122
Mild-Moderate	1.10	0.41	3.00	0.849		1.21	0.44	3.35	0.716		1.07	0.35	3.28	0.911	
Severe	0.48	0.18	1.29	0.144		0.64	0.22	1.83	0.406		0.42	0.11	1.56	0.198	
Very Severe	0.39	0.14	1.14	0.086		0.38	0.13	1.12	0.078		0.41	0.09	1.75	0.226	
Worst Pain Severity [NRS 0-10]	-1.29	-2.47	-0.12	0.031	149	-1.13	-2.33	0.06	0.063	149	-0.90	-2.16	0.36	0.159	122
Current Pain Severity [NRS 0-10]	-0.42	-1.17	0.33	0.272	149	-0.40	-1.17	0.38	0.312	149	-0.31	-1.09	0.47	0.430	122
Total Days with Back Pain	3.53	-9.84	16.90	0.602	145	3.09	-10.53	16.72	0.654	145	4.13	-9.00	17.25	0.535	119
Total Days with Back Pain [reference: No back pain]					145					145					119
1-7 Days	0.49	0.21	1.16	0.104		0.59	0.24	1.42	0.238		0.62	0.22	1.72	0.359	
8-180 Days	0.49	0.18	1.34	0.164		0.47	0.17	1.30	0.144		0.49	0.13	1.81	0.284	
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.33	0.15	0.73	0.006		0.38	0.17	0.85	0.019		0.43	0.17	1.13	0.086	
6 to 12 weeks	0.81	0.15	4.33	0.806		0.82	0.15	4.45	0.820		0.86	0.13	5.80	0.873	
12 weeks or longer	1.62	0.18	14.26	0.663		1.75	0.19	15.80	0.620			‡			
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Up to 6 weeks	0.33	0.15	0.73	0.006		0.38	0.17	0.85	0.019		0.43	0.17	1.12	0.085	
6 weeks or longer	1.08	0.28	4.20	0.910		1.10	0.28	4.34	0.888		1.09	0.20	6.04	0.918	
Medication for Back Pain [Yes/No]	0.80	0.38	1.70	0.561	148	0.77	0.35	1.67	0.503	148	0.75	0.29	1.93	0.545	120
Health Care Provider Visit [Yes/No]	0.96	0.32	2.88	0.939	148	0.97	0.31	2.99	0.953	148	0.90	0.25	3.33	0.881	120
Activitiy Limitations [Yes/No]	0.35	0.16	0.77	0.009	147	0.37	0.17	0.83	0.015	147	0.32	0.12	0.84	0.021	119
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.53	0.19	1.49	0.232	148	0.54	0.18	1.55	0.249	148	0.37	0.09	1.53	0.171	109

Table 8-3c (Cont.). Association between exercise (home or UCLA) and 6-months prevalence and severity of low back pain.

	Unadjusted					**Model 1 (adjusted for Sex and Age)**					**Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)**				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**
***Exercise home within 2hrs waking or UCLA "Warm up for work" within 2hrs waking* [Yes/No]**															
Any Back Pain [Yes/No]	0.59	0.30	1.14	0.115	148	0.60	0.31	1.18	0.140	148	0.64	0.29	1.42	0.272	121
Back Pain Radiating Past Knee [Yes/No]	0.83	0.40	1.76	0.635	148	0.82	0.39	1.74	0.603	148	0.94	0.34	2.57	0.897	121
Average Pain Severity [NRS 0-10]	-0.91	-1.81	-0.01	0.047	147	-0.87	-1.79	0.04	0.060	147	-0.46	-1.42	0.50	0.344	121
Average Pain Severity [High/Low]	0.51	0.25	1.06	0.070	147	0.54	0.26	1.14	0.107	147	0.67	0.26	1.73	0.404	121
Average Pain Severity [reference: None]					147					147					121
Mild-Moderate	0.65	0.29	1.48	0.307		0.68	0.30	1.58	0.371		0.71	0.28	1.80	0.465	
Severe	0.55	0.22	1.40	0.211		0.67	0.25	1.79	0.427		0.60	0.17	2.13	0.426	
Very Severe	0.33	0.11	0.97	0.044		0.30	0.10	0.91	0.034		0.48	0.11	2.05	0.324	
Worst Pain Severity [NRS 0-10]	-0.77	-1.83	0.28	0.150	147	-0.66	-1.73	0.40	0.220	147	-0.33	-1.46	0.80	0.567	121
Current Pain Severity [NRS 0-10]	-0.32	-0.98	0.34	0.344	147	-0.31	-0.98	0.36	0.357	147	-0.04	-0.73	0.66	0.915	121
Total Days with Back Pain	6.52	-4.61	17.65	0.248	143	5.80	-5.50	17.09	0.312	143	7.89	-3.90	19.69	0.188	118
Total Days with Back Pain [reference: No back pain]					143					143					118
1-7 Days	0.30	0.13	0.69	0.005		0.32	0.14	0.76	0.010		0.41	0.15	1.07	0.069	
8-180 Days	0.92	0.35	2.40	0.857		0.88	0.33	2.33	0.800		1.01	0.31	3.33	0.986	
Longest Episode of Back Pain [reference: No back pain]					147					147					120
Up to 6 weeks	0.43	0.20	0.93	0.031		0.47	0.22	1.03	0.060		0.59	0.24	1.44	0.245	
6 to 12 weeks	0.72	0.17	3.07	0.659		0.71	0.17	3.06	0.650		0.90	0.18	4.51	0.898	
12 weeks or longer	0.72	0.14	3.77	0.700		0.73	0.14	3.86	0.706				‡		
Longest Episode of Back Pain [reference: No back pain]					147					147					120
Up to 6 weeks	0.43	0.20	0.93	0.031		0.47	0.22	1.03	0.060		0.62	0.25	1.49	0.282	
6 weeks or longer	0.72	0.23	2.23	0.571		0.71	0.23	2.22	0.560		0.55	0.13	2.32	0.417	
Medication for Back Pain [Yes/No]	0.78	0.39	1.55	0.479	146	0.76	0.38	1.52	0.432	146	0.76	0.33	1.77	0.528	119
Health Care Provider Visit [Yes/No]	1.17	0.44	3.17	0.751	146	1.16	0.42	3.21	0.769	146	0.90	0.27	3.00	0.870	119
Activitiy Limitations [Yes/No]	0.57	0.27	1.20	0.141	145	0.59	0.28	1.27	0.176	145	0.64	0.27	1.54	0.316	118
At Least One Day Away from Work Due to Back Pain [Yes/No]	0.41	0.15	1.17	0.097	146	0.39	0.13	1.15	0.087	146	0.35	0.09	1.35	0.126	108

† - Effect sizes for dichotomous outcome variables are odds ratios; for continuous variables (Numeric rating scale, and Total Days with Back Pain) effect sizes are the linear regression coefficient; and for outcome variables with more than two ordinal levels the effect sizes are given as the relative risk ratio.
‡ - Sample size within cell (Exposure/Outcome combination) too small.

Table 8-3d. Association between activity and/or exercise (home or UCLA) within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure *Outcome* **Exposure Level** Outcome Level	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**	**Effect Size†**	**Lower CI**	**Upper CI**	**p-Value**	**N**
High Activity and Exercise [reference: no activity, no exercise within 2hrs of waking]															
Any Back Pain [Yes/No]					150					150					122
Minimal Activity/Minimal Exercise	1.23	0.45	3.32	0.686	32	1.24	0.45	3.39	0.676	32	1.75	0.51	6.07	0.376	27
Minimal Activity/Exercise	0.65	0.20	2.12	0.481	17	0.70	0.21	2.31	0.559	17	1.64	0.37	7.23	0.517	15
Moderate Activity/No Exercise	0.84	0.25	2.87	0.784	15	0.81	0.23	2.78	0.733	15	1.18	0.26	5.46	0.828	14
Moderate Activity/Exercise	0.68	0.24	1.93	0.470	25	0.69	0.24	1.98	0.490	25	0.96	0.24	3.80	0.951	18
High Activity/No Exercise	6.63	0.75	58.56	0.089	10	6.13	0.69	54.71	0.105	10	10.30	0.82	129.57	0.071	9
High Activity/Exercise	1.16	0.36	3.74	0.806	18	1.12	0.34	3.69	0.850	18	1.35	0.31	5.93	0.692	15
Back Pain Radiating Past Knee [Yes/No]					150					150					122
Minimal Activity/Minimal Exercise	1.22	0.40	3.70	0.722	32	1.21	0.40	3.69	0.736	32	1.79	0.37	8.65	0.467	27
Minimal Activity/Exercise	0.42	0.08	2.23	0.306	17	0.40	0.07	2.15	0.285	17	1.59	0.18	13.81	0.674	15
Moderate Activity/No Exercise	0.48	0.09	2.60	0.395	15	0.49	0.09	2.69	0.415	15	1.57	0.20	12.46	0.667	14
Moderate Activity/Exercise	0.78	0.22	2.76	0.702	25	0.78	0.22	2.77	0.699	25	1.82	0.29	11.45	0.522	18
High Activity/No Exercise	3.13	0.72	13.64	0.130	10	3.31	0.74	14.72	0.116	10	11.74	1.37	100.22	0.024	9
High Activity/Exercise	1.56	0.44	5.52	0.488	18	1.57	0.44	5.64	0.489	18	2.09	0.31	13.96	0.447	15
Average Pain Severity [NRS 0-10]					149					149					122
Minimal Activity/Minimal Exercise	-1.00	-2.32	0.32	0.136	32	-0.97	-2.30	0.37	0.155	32	-0.34	-1.74	1.06	0.630	27
Minimal Activity/Exercise	-1.10	-2.68	0.48	0.172	17	-1.03	-2.63	0.57	0.207	17	0.43	-1.25	2.10	0.616	15
Moderate Activity/No Exercise	-0.89	-2.54	0.76	0.290	15	-0.94	-2.60	0.72	0.266	15	-0.52	-2.24	1.21	0.555	14
Moderate Activity/Exercise	-1.37	-2.78	0.04	0.057	25	-1.37	-2.79	0.04	0.057	25	-1.32	-2.90	0.26	0.101	18
High Activity/No Exercise	2.11	0.20	4.02	0.031	10	2.02	0.09	3.95	0.041	10	2.48	0.42	4.55	0.019	9
High Activity/Exercise	0.81	-0.74	2.37	0.303	18	0.84	-0.74	2.42	0.295	18	1.19	-0.52	2.90	0.171	15
Average Pain Severity [High/Low]					149					149					122
Minimal Activity/Minimal Exercise	0.47	0.16	1.40	0.175	32	0.50	0.16	1.53	0.223	32	0.91	0.17	4.93	0.909	27
Minimal Activity/Exercise	0.36	0.08	1.50	0.160	17	0.40	0.09	1.71	0.216	17	1.73	0.20	14.92	0.619	15
Moderate Activity/No Exercise	0.26	0.05	1.34	0.106	15	0.23	0.04	1.20	0.081	15	0.31	0.04	2.52	0.272	14
Moderate Activity/Exercise	0.23	0.06	0.92	0.038	25	0.21	0.05	0.89	0.033	25	0.08	0.01	0.99	0.049	18
High Activity/No Exercise	3.89	0.84	17.96	0.082	10	3.36	0.71	15.85	0.126	10	11.94	0.97	147.24	0.053	9
High Activity/Exercise	1.67	0.52	5.36	0.392	18	1.86	0.55	6.22	0.317	18	4.70	0.71	31.17	0.109	15
Average Pain Severity [reference: None]					149					149					122
Minimal Activity/Minimal Exercise					32					32					27
Mild-Moderate	1.10	0.31	3.92	0.886		1.12	0.31	4.05	0.860		1.18	0.28	5.00	0.827	
Severe	0.69	0.17	2.73	0.593		0.88	0.20	3.80	0.860		0.86	0.10	7.46	0.895	
Very Severe	0.27	0.05	1.58	0.148		0.25	0.04	1.48	0.128		0.90	0.07	10.81	0.933	
Minimal Activity/Exercise					17					17					15
Mild-Moderate	0.93	0.21	4.20	0.928		0.99	0.22	4.50	0.990		1.30	0.23	7.20	0.766	
Severe	0.47	0.08	2.81	0.405		0.61	0.09	4.11	0.614		2.05	0.14	30.65	0.603	
Very Severe	0.23	0.02	2.25	0.208		0.22	0.02	2.19	0.198		1.24	0.06	27.45	0.893	
Moderate Activity/No Exercise					15					15					14
Mild-Moderate	1.46	0.34	6.35	0.615		1.38	0.31	6.06	0.672		1.42	0.25	7.99	0.694	
Severe	0.29	0.03	2.88	0.291		0.23	0.02	2.42	0.221		0.23	0.01	3.87	0.309	
Very Severe	0.29	0.03	2.88	0.291		0.31	0.03	3.10	0.318		0.71	0.04	13.48	0.820	
Moderate Activity/Exercise					25					25					18
Mild-Moderate	1.09	0.29	4.04	0.899		1.08	0.29	4.02	0.913		1.30	0.27	6.32	0.748	
Severe	0.31	0.05	1.81	0.193		0.27	0.04	1.71	0.164			‡			
Very Severe	0.16	0.02	1.46	0.103		0.16	0.02	1.54	0.113		0.32	0.02	5.57	0.437	
High Activity/No Exercise					10					10					9
Mild-Moderate	4.67	0.35	61.83	0.243		4.29	0.32	57.48	0.271		4.99	0.24	103.63	0.299	
Severe	7.00	0.60	81.68	0.121		5.35	0.44	65.65	0.189		14.23	0.44	463.87	0.135	
Very Severe	9.33	0.85	101.95	0.067		10.29	0.90	117.13	0.060		104.76	2.20	4983.51	0.018	
High Activity/Exercise					18					18					15
Mild-Moderate	0.67	0.11	4.20	0.666		0.68	0.11	4.34	0.681		0.60	0.08	4.63	0.622	
Severe	1.67	0.37	7.42	0.503		2.44	0.48	12.34	0.281		3.26	0.30	35.78	0.333	
Very Severe	1.33	0.28	6.33	0.717		1.17	0.24	5.74	0.843		5.05	0.32	79.21	0.249	

Table 8-3d (Cont.). Association between activity and/or exercise (home or UCLA) within 2hrs of waking and 6-months prevalence and severity of low back pain.

	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
Exposure / *Outcome* / **Exposure Level** / Outcome Level	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
High Activity and Exercise [reference: no activity, no exercise within 2hrs of waking] (cont.)															
Worst Pain Severity [NRS 0-10]					149					149					122
Minimal Activity/Minimal Exercise	-0.50	-2.07	1.07	0.529	32	-0.41	-1.98	1.16	0.608	32	-0.08	-1.76	1.59	0.923	27
Minimal Activity/Exercise	-0.75	-2.63	1.13	0.432	17	-0.58	-2.47	1.30	0.542	17	0.60	-1.41	2.60	0.558	15
Moderate Activity/No Exercise	-0.35	-2.31	1.61	0.725	15	-0.47	-2.43	1.49	0.635	15	-0.53	-2.60	1.54	0.613	14
Moderate Activity/Exercise	-1.03	-2.70	0.64	0.225	25	-1.05	-2.73	0.62	0.214	25	-1.53	-3.42	0.37	0.113	18
High Activity/No Exercise	2.45	0.18	4.72	0.035	10	2.24	-0.04	4.51	0.054	10	2.05	-0.42	4.52	0.103	9
High Activity/Exercise	1.36	-0.48	3.21	0.147	18	1.45	-0.41	3.31	0.126	18	1.42	-0.63	3.47	0.172	15
Current Pain Severity [NRS 0-10]					149					149					122
Minimal Activity/Minimal Exercise	-1.03	-2.01	-0.05	0.040	32	-1.03	-2.02	-0.04	0.042	32	-0.92	-1.95	0.11	0.081	27
Minimal Activity/Exercise	-0.98	-2.16	0.20	0.103	17	-0.95	-2.14	0.24	0.117	17	-0.18	-1.42	1.05	0.771	15
Moderate Activity/No Exercise	-1.56	-2.79	-0.33	0.013	15	-1.58	-2.82	-0.34	0.013	15	-1.37	-2.64	-0.10	0.035	14
Moderate Activity/Exercise	-0.91	-1.95	0.14	0.090	25	-0.90	-1.96	0.16	0.095	25	-0.48	-1.64	0.69	0.419	18
High Activity/No Exercise	0.98	-0.45	2.40	0.178	10	0.94	-0.50	2.38	0.200	10	0.70	-0.82	2.22	0.364	9
High Activity/Exercise	0.15	-1.00	1.31	0.794	18	0.14	-1.04	1.32	0.815	18	-0.13	-1.39	1.13	0.838	15
Total Days with Back Pain					145					145					119
Minimal Activity/Minimal Exercise	-3.82	-21.72	14.08	0.674	29	-4.64	-22.66	13.38	0.612	29	-9.37	-27.30	8.56	0.302	25
Minimal Activity/Exercise	10.18	-10.77	31.13	0.338	17	9.68	-11.45	30.81	0.366	17	13.06	-7.99	34.11	0.221	15
Moderate Activity/No Exercise	-2.67	-24.52	19.17	0.809	15	-2.08	-24.07	19.90	0.852	15	-2.36	-24.15	19.44	0.831	14
Moderate Activity/Exercise	6.51	-12.34	25.36	0.496	24	7.34	-11.64	26.32	0.446	24	12.07	-8.68	32.83	0.251	17
High Activity/No Exercise	36.29	11.00	61.58	0.005	10	36.92	11.37	62.46	0.005	10	11.08	-14.92	37.09	0.400	9
High Activity/Exercise	19.26	-1.31	39.83	0.066	18	17.50	-3.39	38.40	0.100	18	9.22	-12.25	30.70	0.396	15
Total Days with Back Pain [reference: No back pain]					145					145					119
Minimal Activity/Minimal Exercise					29					29					25
1-7 Days	1.23	0.41	3.72	0.708		1.33	0.42	4.21	0.627		2.50	0.55	11.32	0.233	
8-180 Days	0.37	0.04	3.89	0.408		0.36	0.03	3.81	0.398		0.31	0.02	4.27	0.384	
Minimal Activity/Exercise					17					17					15
1-7 Days	0.40	0.07	2.21	0.296		0.45	0.08	2.60	0.374		1.08	0.14	8.59	0.942	
8-180 Days	2.42	0.46	12.85	0.298		2.33	0.44	12.44	0.323		4.47	0.48	42.07	0.190	
Moderate Activity/No Exercise					15					15					14
1-7 Days	0.99	0.24	4.07	0.986		0.86	0.20	3.68	0.836		0.90	0.15	5.32	0.906	
8-180 Days	1.48	0.21	10.46	0.693		1.57	0.22	11.27	0.652		1.03	0.09	11.39	0.982	
Moderate Activity/Exercise					24					24					17
1-7 Days	0.23	0.04	1.23	0.086		0.21	0.04	1.16	0.073		0.11	0.01	1.33	0.082	
8-180 Days	1.05	0.19	5.87	0.953		1.09	0.19	6.15	0.920		1.01	0.11	8.98	0.995	
High Activity/No Exercise					10					10					9
1-7 Days	11.11	1.13	109.35	0.039		8.88	0.88	90.08	0.065		12.79	0.88	185.13	0.062	
8-180 Days	26.67	2.18	326.45	0.010		29.13	2.32	365.49	0.009		8.09	0.30	216.06	0.212	
High Activity/Exercise					18					18					15
1-7 Days	0.99	0.24	4.07	0.986		1.06	0.24	4.65	0.936		1.35	0.22	8.30	0.748	
8-180 Days	3.70	0.72	18.97	0.116		3.61	0.69	18.89	0.128		1.44	0.16	13.05	0.743	
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Minimal Activity/Minimal Exercise					31					31					26
Up to 6 weeks	0.67	0.20	2.19	0.504		0.70	0.21	2.39	0.572		0.85	0.19	3.92	0.839	
6 to 12 weeks		‡					‡					‡			
12 weeks or longer		‡					‡					‡			
Minimal Activity/Exercise					17					17					15
Up to 6 weeks	0.89	0.22	3.54	0.867		1.06	0.25	4.43	0.939		2.13	0.35	12.86	0.410	
6 to 12 weeks	2.00	0.25	16.16	0.516		2.14	0.26	17.84	0.481		1.59	0.12	21.46	0.728	
12 weeks or longer		‡					‡					‡			
Moderate Activity/No Exercise					15					15					14
Up to 6 weeks	1.09	0.27	4.45	0.908		0.95	0.22	4.04	0.947		0.86	0.15	4.96	0.868	
6 to 12 weeks	2.44	0.30	20.11	0.406		2.50	0.29	21.20	0.402		1.12	0.10	12.72	0.924	
12 weeks or longer		‡					‡					‡			
Moderate Activity/Exercise					25					25					18
Up to 6 weeks	0.49	0.13	1.84	0.290		0.46	0.12	1.80	0.265		0.51	0.10	2.75	0.435	
6 to 12 weeks	0.55	0.05	6.54	0.636		0.59	0.05	7.12	0.679		0.57	0.04	9.01	0.689	
12 weeks or longer		‡					‡					‡			
High Activity/No Exercise					10					10					9
Up to 6 weeks	17.13	1.83	160.06	0.013		14.43	1.51	138.14	0.021		21.07	1.50	296.86	0.024	
6 to 12 weeks		‡					‡					‡			
12 weeks or longer		‡					‡					‡			
High Activity/Exercise					18					18					15
Up to 6 weeks	1.63	0.45	5.93	0.459		1.79	0.46	6.86	0.398		2.13	0.38	11.85	0.386	
6 to 12 weeks	1.22	0.10	15.23	0.876		1.03	0.08	13.32	0.979		0.54	0.03	8.83	0.667	
12 weeks or longer		‡					‡					‡			

Table 8-3d (Cont.). Association between activity and/or exercise (home or UCLA) within 2hrs of waking and 6-months prevalence and severity of low back pain.

Exposure / *Outcome* / **Exposure Level** / Outcome Level	Unadjusted					Model 1 (adjusted for Sex and Age)					Model 2 (adjusted for Sex, Age, Lifts/Day>25 Pounds, Tenure, Assigned Shift, Sleep Duration, Language, Has 2nd Job, and Stress Level)				
	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N	Effect Size†	Lower CI	Upper CI	p-Value	N
High Activity and Exercise [reference: no activity, no exercise within 2hrs of waking] (cont.)															
Longest Episode of Back Pain [reference: No back pain]					149					149					121
Minimal Activity/Minimal Exercise					31					31					26
Up to 6 weeks	0.67	0.20	2.19	0.504		0.70	0.21	2.38	0.568		0.73	0.16	3.27	0.683	
6 weeks or longer	1.50	0.23	9.87	0.673		1.51	0.23	9.96	0.669		0.55	0.06	5.20	0.606	
Minimal Activity/Exercise					17					17					15
Up to 6 weeks	0.89	0.22	3.54	0.867		1.05	0.25	4.41	0.944		2.13	0.36	12.50	0.404	
6 weeks or longer	2.00	0.25	16.16	0.516		2.03	0.25	16.60	0.508		2.25	0.18	27.36	0.526	
Moderate Activity/No Exercise					15					15					14
Up to 6 weeks	1.09	0.27	4.45	0.908		0.96	0.23	4.05	0.952		0.86	0.15	4.90	0.868	
6 weeks or longer	2.44	0.30	20.12	0.406		2.41	0.29	20.03	0.417		1.46	0.13	16.56	0.761	
Moderate Activity/Exercise					25					25					18
Up to 6 weeks	0.49	0.13	1.84	0.290		0.46	0.12	1.81	0.269		0.51	0.10	2.69	0.427	
6 weeks or longer	0.55	0.05	6.54	0.636		0.55	0.05	6.53	0.633		0.46	0.03	7.39	0.584	
High Activity/No Exercise					10					10					9
Up to 6 weeks	17.11	1.83	159.80	0.013		14.53	1.52	139.01	0.020		18.86	1.36	262.23	0.029	
6 weeks or longer	22.00	1.33	362.92	0.031		21.57	1.29	360.24	0.032		1.66	0.03	101.36	0.810	
High Activity/Exercise					18					18					15
Up to 6 weeks	1.63	0.45	5.93	0.459		1.77	0.46	6.78	0.404		2.06	0.38	11.17	0.404	
6 weeks or longer	3.67	0.52	25.77	0.192		3.70	0.52	26.53	0.193		0.53	0.03	8.70	0.653	
Medication for Back Pain [Yes/No]					148					148					120
Minimal Activity/Minimal Exercise	2.23	0.74	6.69	0.153	32	2.14	0.71	6.46	0.177	32	2.71	0.68	10.87	0.159	27
Minimal Activity/Exercise	1.55	0.41	5.89	0.522	17	1.52	0.40	5.82	0.544	17	2.33	0.41	13.35	0.344	15
Moderate Activity/No Exercise	3.25	0.87	12.09	0.079	15	3.43	0.91	12.95	0.069	15	4.00	0.77	20.79	0.099	14
Moderate Activity/Exercise	1.17	0.34	4.06	0.801	25	1.23	0.35	4.27	0.750	25	1.17	0.23	5.89	0.847	18
High Activity/No Exercise	4.64	0.98	22.03	0.053	9	5.15	1.05	25.15	0.043	9	8.01	1.02	62.65	0.047	8
High Activity/Exercise	3.30	0.93	11.71	0.065	17	3.08	0.86	11.03	0.084	17	2.52	0.48	13.26	0.276	14
Health Care Provider Visit [Yes/No]					148					148					120
Minimal Activity/Minimal Exercise	0.67	0.13	3.40	0.626	32	0.75	0.14	3.93	0.732	32	1.35	0.19	9.78	0.768	27
Minimal Activity/Exercise	1.00	0.17	5.83	1.000	17	1.34	0.22	8.32	0.751	17	2.25	0.20	25.50	0.512	15
Moderate Activity/No Exercise	1.17	0.20	6.89	0.865	15	1.49	0.23	9.42	0.673	15	2.09	0.23	18.68	0.508	14
Moderate Activity/Exercise	0.64	0.11	3.61	0.610	25	0.87	0.14	5.22	0.879	25	0.82	0.08	8.80	0.870	18
High Activity/No Exercise	1.33	0.18	9.91	0.779	9	1.90	0.22	16.09	0.557	9	4.35	0.35	54.48	0.255	8
High Activity/Exercise			‡		17			‡		17			‡		14
Activitiy Limitations [Yes/No]					147					147					119
Minimal Activity/Minimal Exercise	0.88	0.28	2.78	0.821	32	0.89	0.28	2.87	0.849	32	0.82	0.20	3.34	0.777	27
Minimal Activity/Exercise	1.30	0.35	4.84	0.693	17	1.43	0.38	5.43	0.597	17	1.58	0.30	8.37	0.589	15
Moderate Activity/No Exercise	1.56	0.41	5.95	0.513	15	1.48	0.39	5.72	0.566	15	1.27	0.26	6.18	0.771	14
Moderate Activity/Exercise	0.43	0.10	1.81	0.247	25	0.43	0.10	1.83	0.250	25	0.47	0.09	2.50	0.373	18
High Activity/No Exercise	5.21	1.01	26.79	0.048	8	4.81	0.91	25.30	0.064	8	3.06	0.38	24.43	0.292	7
High Activity/Exercise	1.70	0.48	6.09	0.412	17	1.72	0.47	6.27	0.415	17	1.46	0.29	7.38	0.645	14
At Least One Day Away from Work Due to Back Pain [Yes/No]					148					148					120
Minimal Activity/Minimal Exercise	0.80	0.19	3.29	0.757	32	0.72	0.17	3.09	0.662	32	1.03	0.16	6.60	0.975	27
Minimal Activity/Exercise	0.35	0.04	3.27	0.357	17	0.38	0.04	3.71	0.408	17	0.87	0.07	11.00	0.913	15
Moderate Activity/No Exercise	2.04	0.46	9.02	0.349	15	2.18	0.46	10.39	0.327	15	3.91	0.54	28.48	0.178	14
Moderate Activity/Exercise	0.23	0.03	2.14	0.198	25	0.25	0.03	2.38	0.229	25	0.57	0.05	6.79	0.654	18
High Activity/No Exercise	1.60	0.25	10.05	0.616	9	1.89	0.27	13.22	0.521	9	6.28	0.51	77.54	0.152	8
High Activity/Exercise	0.35	0.04	3.27	0.357	17	0.26	0.03	2.58	0.252	17			‡		14

† - Effect sizes for dichotomous outcome variables are odds ratios; for continuous variables (Numeric rating scale, and Total Days with Back Pain) effect sizes are the linear regression coefficient; and for outcome variables with more than two ordinal levels the effect sizes are given as the relative risk ratio.
‡ - Sample size within cell (Exposure/Outcome combination) too small.

8.2 RESULTS OF PROSPECTIVE IMPACT OF TRAINING INTERVENTION

Of 290 eligible custodians, 157 were recruited, consented and randomized by supervisors into a sham group (n=77) and a treatment group (n=80). The majority of subjects were male (56%), chose English-language questionnaires (63%), and worked night shifts (77% - day shifts started between 4:00 a.m. and 9:30 a.m., night shifts at 5:30pm). Average age and job tenure were 47.5 years and 8.4 years, respectively. At the year-one follow-up only 94 subjects completed the questionnaire (60% of those that originally consented). However, subsequent to completing the year-one follow-up questionnaire all custodians, both those who consented and those who didn't originally consent to the study, received training within their supervisor groups, because the institution made it mandatory for everybody. At the two-year follow-up 113 subjects (72% participation rate) completed the questionnaire.

Table 8-4 shows sample demographic, personal, and job characteristics by intervention and study phase (for additional details see section 8.1 of this dissertation). Despite fewer subjects completing the follow-up questionnaires, most of these characteristics remained very similar across study phases. The one notable exception being the year-two number of lifts over 25 pounds per day which increased over baseline by two (30% increase) and three (69% increase) for sham and treatment groups, respectively.

Table 8-5 shows unadjusted times between waking and leaving for or arriving at work at each phase of the study. Between baseline and the year-one follow-up, the time between rising and leaving for and arriving at worked dropped for sham subjects but increased slightly for treatment subjects. Then, at the year-two follow-up the times for sham subjects returned to the baseline times and the intervention group subjects average times decreased from both baseline and two-year follow-up.

Table 8-6 shows spine-loading activities after waking. At baseline activity and exercise proportions and levels are very similar between sham and treatment subjects. At each follow up year, activity levels and exercise decrease for both sham and treatment subjects.

Table 8-7 shows back pain outcomes at each phase of the study. Between baseline and year two any form of back pain increased for both original sham and treatment groups but more for sham (35% vs 21%), as did seeking medical care for back pain (21% vs 2%). Sciatica, average back pain, worst back pain decreased in both groups but less in the sham group (36% vs. 44%, 8% vs.33%, 18% vs 36%). Activity limitations decreased about equally over 40% in both groups. Back pain resulting in days away from work decreased for the sham group (6% decrease), but increased for the treatment group (48% increase). However, current back pain, total days with back pain, taking medicine for back pain, and self-reported claims for back pain decreased for the treatment group (decreases of 18%, 19%, 31%, and 64% respectively) and increased for the sham group (increases of 9%, 8%, 12%, and 40% respectively).

Table 8-4. Sample Characteristics and Potential Confounding Factors by Survey and Type Of Training.

	Baseline (N=157)				Year1 (N=94)				Year2 (N=113)			
	Sham		Treatment		Sham		Treatment.		Sham		Treatment	
	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)
	Range		*Range*		*Range*		*Range*		*Range*		*Range*	
Age (yrs)	48.7	(9.3)	46.2	(10.3)	49.2	(9.4)	46.2	(10.7)	51.7	(8.8)	49.3	(9.1)
Range	*[23-64]*		*[21-76]*		*[26-65]*		*[20-77]*		*[26-66]*		*[26-78]*	
Sex												
Male	48	62.3%	40	50.0%	28	62.2%	23	46.9%	33	58.9%	27	47.4%
Female	29	37.7%	40	50.0%	17	37.8%	26	53.1%	23	41.1%	30	52.6%
Language												
English	47	61.0%	52	65.0%	33	73.3%	33	67.3%	36	64.3%	37	64.9%
Spanish	30	39.0%	28	35.0%	12	26.7%	16	32.7%	20	35.7%	20	35.1%
Sleep Time (hrs/day)	6.4	(1.5)	6.7	(1.7)	7.2	(1.9)	6.8	(1.5)	6.8	(1.6)	6.5	(1.6)
Range	*[2-10]*		*[3-12.5]*		*[4-14]*		*[2-12]*		*[1-11]*		*[1-10]*	
Stress level past week												
None	46	67.6%	43	58.1%	30	68.2%	30	65.2%	34	63.0%	30	58.8%
Some	16	23.5%	25	33.8%	9	20.5%	13	28.3%	13	24.1%	17	33.3%
Most	6	8.8%	6	8.1%	5	11.4%	3	6.5%	7	13.0%	4	7.8%
Tenure (yrs)	8.10	(6.68)	8.73	(7.85)	8.35	(6.32)	8.59	(7.26)	8.98	(6.05)	10.58	(7.43)
Range	*[0.04-30.57]*		*[0.06-28.46]*		*[1.08-24.13]*		*[1.06-28.81]*		*[2.08-32.57]*		*[2.10-30.46]*	
Shift												
Day	16	20.8%	19	23.8%	10	22.2%	11	22.4%	12	21.4%	15	26.3%
Night	61	79.2%	61	76.3%	35	77.8%	38	77.6%	44	78.6%	42	73.7%

Number of lifts over 25 pounds/day	6.1	(9.5)	4.9	(6.8)	5.9	(8.7)	5.6	(7.7)	7.9	(12.1)	8.3	(13.0)
Range	*[0-50]*		*[0-40]*		*[0-50]*		*[0-40]*		*[0-50]*		*[0-50]*	
Have More than UCLA Job												
No	64	88.9%	72	91.1%	40	95.2%	39	84.8%	49	92.5%	47	88.7%
Yes	8	11.1%	7	8.9%	2	4.8%	7	15.2%	4	7.5%	6	11.3%

Table 8-5. Predictors of LBP: Time Between Waking and Leaving for Work or Arriving at Work

	Baseline (N=157)				Year1 (N=94)				Year2 (N=113)			
	Sham		Treatment		Sham		Treatment		Sham		Treatment	
	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)
Time (hrs) between Rising & Leaving for Work	4.6	(2.7)	4.5	(2.8)	3.8	(2.6)	4.7	(2.8)	4.6	(2.8)	4.1	(3.0)
Time (hrs) between Rising & Arriving at Work	5.9	(2.8)	5.5	(3.1)	5.1	(2.8)	5.4	(3.3)	5.8	(2.9)	5.2	(3.3)
Wake-to-Leave Time												
> 2hrs	50	70.4%	53	70.7%	22	64.7%	25	71.4%	25	71.4%	27	64.3%
<= 2hrs	21	29.6%	22	29.3%	12	35.3%	10	28.6%	10	28.6%	15	35.7%
Wake-to-Work Time												
> 2hrs	58	81.7%	57	76.0%	25	73.5%	25	71.4%	27	77.1%	28	66.7%
<= 2hrs	13	18.3%	18	24.0%	9	26.5%	10	28.6%	8	22.9%	14	33.3%

Table 8-6. Spine Loading Activities

	Baseline (%) (N=157)		Year1 (%) (N=94)		Year2 (%) (N=113)	
	Sham	Treatment	Sham	Treatment	Sham	Treatment
Activity Level within 2hrs rising						
None	32	35	40	36	50	43
Minimal	23	22	33	44	35	26
Moderate	29	19	15	16	8	20
Considerable	10	15	8	2	4	4
Always	6	8	5	2	2	7
Exercise at home within 2hrs rising	50	50	48	29	44	44
UCLA "Warm up for work" Exercise	56	54	30	33	25	35
UCLA Exercise Within 2hrs of Rising	7	12	3	2	4	13
UCLA or Exercise at Home	74	72	52	48	52	56
Exercise Home or UCLA within 2hrs Rising	51	53	49	30	48	48
Activity-Exercise Levels within 2Hrs Rising						
No Activity/No Exercise	21	23	27	31	31	32
Minimal Activity/Minimal Exercise	21	22	31	35	35	23
Minimal Activity/Exercise	14	9	11	13	17	11
Moderate Activity/No Exercise	14	6	7	8	4	6
Moderate Activity/Exercise	15	18	13	8	8	19
High Activity/No Exercise	7	6	2	2	4	6
High Activity/Exercise	8	15	9	2	2	4

Table 8-7. Back Pain Experience

	Baseline (N=157)				Year1 (N=94)				Year2 (N=113)			
	Sham		Treatment		Sham		Treatment		Sham		Treatment	
	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	%/(SD)	n/mean	n/mean	%/(SD)	n/mean
Any Back Pain		58.4		56.3		62.2		55.1		78.6		68.4
Back Pain past the knee (Sciatica)		24.7		22.5		11.6		14.3		15.7		12.7
Average Back Pain Level (NRS Pain 0-10)	2.4	(2.9)	2.1	(2.7)	1.9	(2.7)	1.9	(2.9)	2.2	(3.0)	1.4	(2.6)
Worst Back Pain Level (NRS Pain 0-10)	2.8	(3.4)	2.5	(3.1)	2.3	(3.3)	2.3	(3.5)	2.3	(3.2)	1.6	(3.0)
Current Back Pain Level (NRS Pain 0-10)	1.1	(2.2)	1.1	(2.1)	0.9	(1.9)	1.3	(2.3)	1.2	(2.3)	0.9	(1.8)
Total Days with Back Pain	15.7	(42.4)	7.9	(29.0)	21.9	(70.5)	27.5	(83.9)	21.4	(71.8)	7.9	(28.0)
Longest Episode												
None		64.5		63.7		71.4		70.2		64.0		76.0
Less than 6 Weeks		23.7		27.5		19.0		19.1		24.0		16.0
6-12 Weeks		7.9		2.5		2.4		4.3		4.0		2.0
Greater than 12 Weeks		3.9		6.3		7.1		6.4		8.0		6.0
Took Medicine		30.7		33.8		24.4		22.4		33.3		23.2
Received Medical Care		10.7		12.5		11.1		12.5		13.0		12.7
Activity Limitations		27.0		25.0		8.9		20.4		15.1		14.3
Lost One Day Or More		16.0		7.5		15.6		16.7		15.1		11.1

Workers' Compensation Claim (self-reported)	4.0	5.0	2.2	0	5.6	1.8

Figure 8-5 and Table 8-8 summarize the mixed effects analyses for each of the outcome measures by sham and treatment training after adjusting for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress.

The odds ratios and severity scores decreased for 13 out of the 15 back pain outcomes with treatment training and, except for sciatica and activity limitations, all more than with sham training; only three of the outcome measures increased for the treatment training: any back pain, receiving medical care for back pain, and at least one day away from work.

Neither sham nor treatment training effects were statistically significant at the $p \leq 0.05$ level, and confidence intervals were wide for most outcome measures, especially for the sham training results that were based on fewer observations than treatment training results. However, the spread of confidence intervals across the null effect value is clearly more aligned with treatment effectiveness. Specifically, the three back pain outcomes for treatment training with the greatest decreases in back pain outcomes (50% for total days with back pain, 47% for medication for back pain, and 33% for average back pain in four levels) had p-levels of 0.1 or less, narrow confidence intervals much more compatible with even larger treatment decreases by up to 78% than with increases of up to 13% as in the case of total days with LBP (OR=0.50, 95%CI 0.22-1.13, p=0.096). Only two of the fifteen back pain outcomes (back pain requiring days away from work and receiving medical care for back pain) showed decreases for the sham training while the treatment training showed increases and only two outcomes (activity limitations due to back pain and sciatica - but the latter based on very small observations) showed greater decreases for the sham training than for the treatment training.

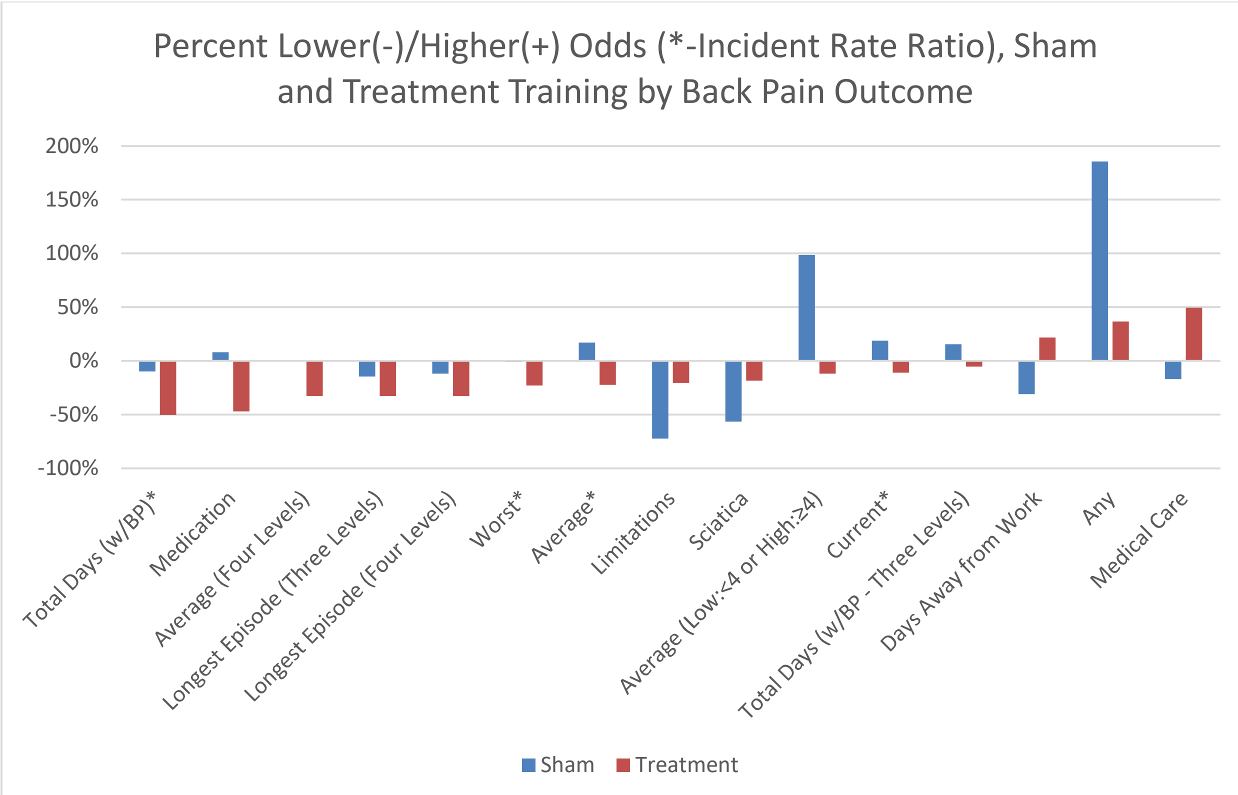

Figure 8-5. Comparison of the fully adjusted effects of sham and treatment training expressed as percent change in two-year back pain frequency, duration, and severity outcomes based on results from mixed effects logistic, ordered logistic, and negative binomial regression analyses reported in Table 8-8.

Differences in recall periods between baseline and follow-up cannot account for differences between sham and treatment training effects. For the one outcome measure with the same recall period across all survey periods (current back pain rating) treatment training resulted in an *11% decrease* (IRR=0.89, CI: 0.58, 1.35,) in contrast to a *19% increase* associated with sham training (IRR=1.19, CI: 0.60, 2.36). Similarly, for the one outcome measure with values adjusted for the difference in recall periods (total days with back pain) treatment training was associated with a 50% decrease (IRR=0.50, CI: 0.22, 1.13) in contrast to sham training which resulted in only a 10% decrease (IRR=0.90, CI: 0.29, 2.83) over the course of the study.

The analysis for self-reported claims was not able to achieve convergence for the chosen model due to small claim counts and so is not included in this table. The likelihood ratio test for each mixed effects analysis showed significance, reflecting the appropriate analysis choice over respective alternative forms of regression analyses.

Table 8-9 summarizes the predicted probabilities of back pain (based on margin analyses of odds ratios estimated by mixed effects logistic and ordered logistic regression) and predicted scores/counts for severity and duration of pain (based on margin analyses of incident rate ratios estimated by mixed effects binomial regression) by intervention (sham or treatment) and study period (baseline, year-one follow-up, and year-two follow-up). The predicted probabilities and predicted scores/counts for all predicted values had relatively wide confidence intervals, especially for the sham effects (not shown in table 8-9, see Appendix XII for confidence intervals). Nevertheless, consistent with the mixed effects main effects, most of the predicted outcome values followed a pattern where, in the treatment group, the probability of back pain and its duration and severity decreased or stayed about the same during the first year of follow-up and then decreased more substantially during the second year of follow-up, while the sham group experienced a slightly increased probability of back pain and its duration and severity during the first year and then also a decrease two years after baseline, however, of a smaller magnitude than the treatment group. This pattern was observed[b] for average, worst, current, and total days with back pain. See Figure 8-6 for longest pain episode (four levels), Figure 8-7 for medication and average (high/low) pain severity, and, Figure 8-8 for average pain severity (four levels), Figure 8-9 for total days (three levels), and Figure 8-10 for longest episode (three levels).

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[b] For outcomes with a "No Back Pain" category, the pattern was for this level to have increased predicted probabilities and scores/counts, reflecting reduction of the pack pain metric.

During the entire two-year follow-up period, subjects in the treatment group experienced a decrease in average and worst back pain by 40%, current back pain by 21%, and total days with back pain by 75%. Based on the question about the longest episode of back pain, the probability of experiencing no back pain at all during follow-up *increased* by 20% and the probability of longer back pain episodes *decreased* by 26% for episodes lasting up to 6 weeks, by 41% for episodes of 6-12 weeks, and 49% for episodes of 12 or more weeks. Similarly, the probability of taking medication for back pain and for having high severity back pain decreased 35% and 11%, respectively, for treatment subjects.

Two outcomes (sciatica and back pain limiting activities) had predicted probabilities that decreased one year after baseline for both sham and treatment subjects (for sham subjects by 42% and 50%, and for treatment subjects by 22% and 23%, respectively) and then increased slightly two years after baseline (Figure 8-11). Two additional outcomes (any back pain and receiving medical care for back pain) increased for treatment subjects one year and two years after baseline, while decreasing (medical care) or increasing (any back pain) one year after baseline for sham subjects, and then increasing (for both groups) two years after baseline (Figure 8-12). The predicted probability of back pain with days away from work increased one year after baseline for the treatment subjects (and to a lesser extent for sham subjects) and then decreased for sham subjects below baseline and decreased for treatment subjects as well, but not below baseline (Figure 8-13).

Changes in predicted probabilities/scores/counts between the year-one follow-up and the year-two follow-up of sham subjects were ±2 percentage points within changes for the sham subjects.
Further detailed descriptions and interpretation of the mixed effects analyses for each outcome measure and their corresponding predicted probabilities and predicted scores/counts can be found in Appendix XII of this dissertation.

Table 8-8. Overall effects of sham and treatment training on 2-year incidence of back pain outcomes: adjusted[1] odds ratios (OR) and incident rate ratios (IRR) with 95% confidence Intervals (CI)from mixed effects logistic, ordered logistic, and negative binomial regression analyses.

	Sham Training Effect			Treatment Training Effect		
Back Pain Measure	OR/IRR*	CI	p-value	OR/IRR*	CI	p-value
Any	2.86	0.93-8.76	0.067	1.37	0.79-2.37	0.271
Sciatica	0.43	0.11-1.66	0.221	0.82	0.42-1.57	0.542
Average	1.17*	0.70-1.95	0.552	0.78*	0.57-1.06	0.112
Worst	0.99*	0.57-1.73	0.978	0.77*	0.56-1.07	0.121
Current	1.19*	0.60-2.36	0.625	0.89*	0.58-1.35	0.579
Total Days with BP	0.90*	0.29-2.83	0.857	0.50*	0.22-1.13	0.096
Longest Episode (Four Levels)	0.88	0.37-2.10	0.774	0.67	0.42-1.09	0.108
Medication	1.08	0.29-4.06	0.910	0.53	0.25-1.10	0.089
Medical Care	0.83	0.13-5.29	0.844	1.50	0.55-4.04	0.427
Activity Limitations	0.28	0.05-1.45	0.127	0.79	0.38-1.64	0.533
At least One Day Away from Work	0.69	0.11-4.46	0.696	1.22	0.49-3.00	0.670
Average Severity of Back Pain (Low:<4 or High:≥4)	1.99	0.65-6.05	0.227	0.88	0.49-1.60	0.674
Average Severity (Four Levels)	0.99	0.42-2.36	0.987	0.67	0.43-1.05	0.082
Total Days with back pain - Three Levels)	1.15	0.44-3.04	0.771	0.95	0.57-1.57	0.834
Longest Episode (Three Levels)	0.85	0.36-2.03	0.719	0.67	0.42-1.09	0.106

Table 8-9. Adjusted[1] predicted probabilities, scores (average, worst, and current back pain), and counts (total days with back pain) of back pain outcomes and back pain severity for all subjects at baseline, and separately, for 12- and 24-month follow-up by intervention group (sham or treatment per original allocation before cross-over). Results from mixed marginal probabilities estimated by logistic, ordered logistic, and negative binomial regression models.

Back Pain Measure	Baseline	Sham Yr1	Sham[2] Yr2	Treat. Yr1	Trea.[2] Yr2
Any	0.57	0.70	0.75	0.60	0.65
Sciatica	0.22	0.12	0.13	0.17	0.18
Average	2.38	2.75	2.16	1.83	1.43
Worst	2.93	3.06	2.24	2.38	1.75
Current	1.01	1.59	1.07	1.19	0.80
Total Days with BP	37.16	78.84	16.60	43.45	9.15
Longest Episode (Four Levels)					
None	0.61	0.59	0.70	0.64	0.73
< 6 Weeks	0.28	0.30	0.24	0.27	0.21
6-12 Weeks	0.05	0.06	0.04	0.05	0.03
≥12 Weeks	0.05	0.06	0.03	0.05	0.03
Medication	0.36	0.30	0.30	0.24	0.23
Medical Care	0.14	0.13	0.15	0.16	0.18
Activity Limitations	0.29	0.14	0.16	0.22	0.25
At least One Day Away from Work	0.13	0.17	0.12	0.20	0.15
Average Severity of Back Pain (Low:<4 or High:≥4)	0.26	0.31	0.33	0.22	0.23
Average Severity (Four Levels)					
None (0)	0.50	0.48	0.56	0.54	0.62
Mild-Moderate (1-3)	0.21	0.22	0.20	0.21	0.19
Severe (4-6)	0.18	0.19	0.15	0.16	0.13
Very Severe (7-10)	0.11	0.12	0.08	0.09	0.06
Total Days with back pain - Three Levels)					
None (0)	0.59	0.57	0.58	0.60	0.61
1-7	0.23	0.24	0.23	0.22	0.22
8-365	0.18	0.20	0.19	0.18	0.17
Longest Episode (Three Levels)					
None	0.61	0.60	0.70	0.64	0.73
< 6 Weeks	0.29	0.29	0.23	0.27	0.21
≥ 6 Weeks	0.10	0.11	0.07	0.09	0.06

1) Models fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress.

2) Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions

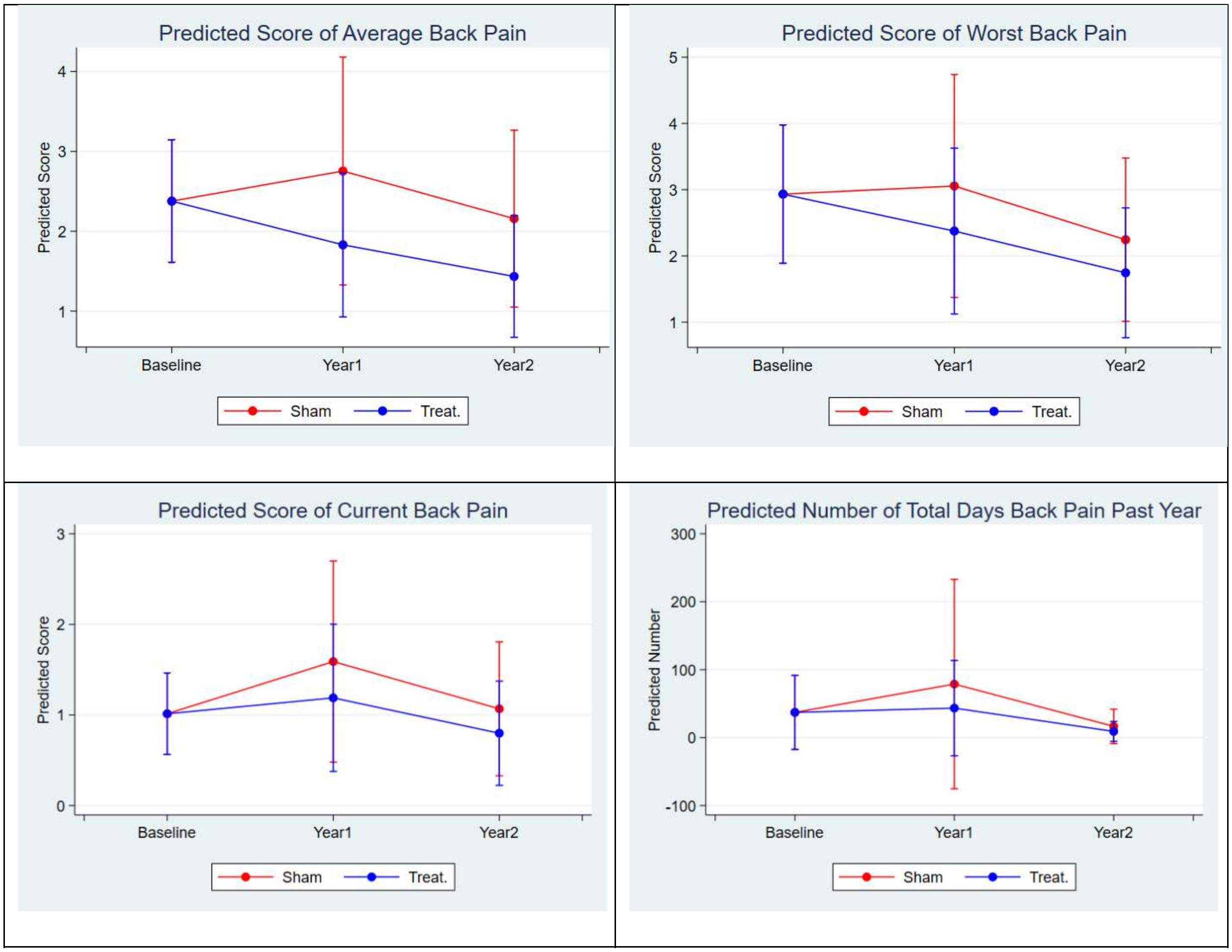


Figure 8-6. Predicted severity scores of average, worst, and current back pain, and predicted number of total days with back pain per year, by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

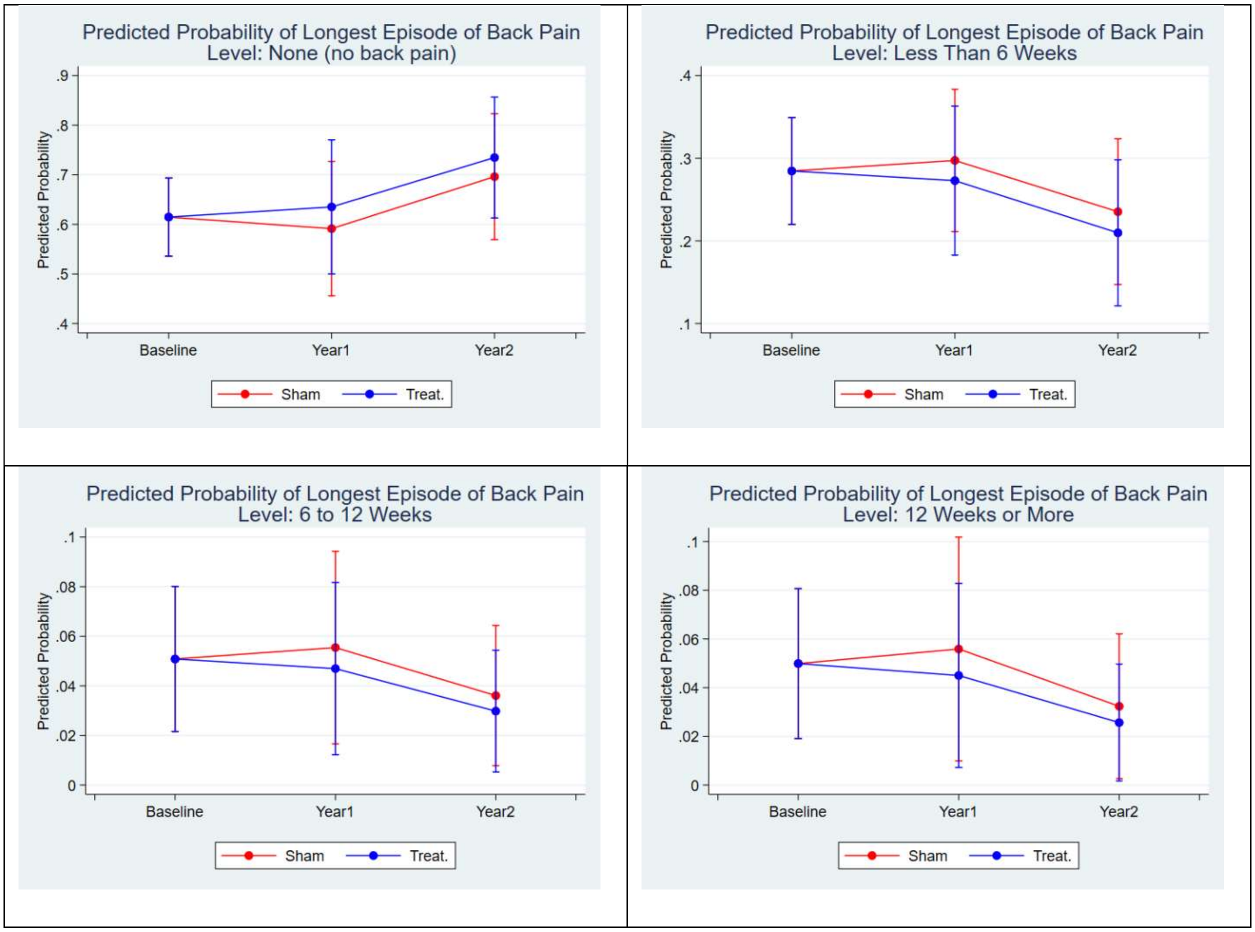
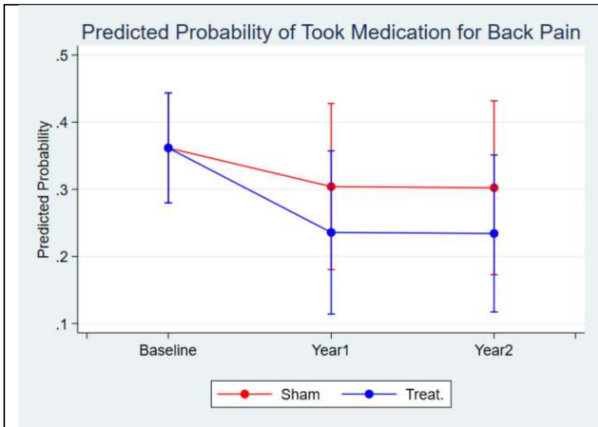


Figure 8-7. Predicted probability of longest episode (none, less than 6 weeks, 6 to 12 weeks, and 12 weeks or more) by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.



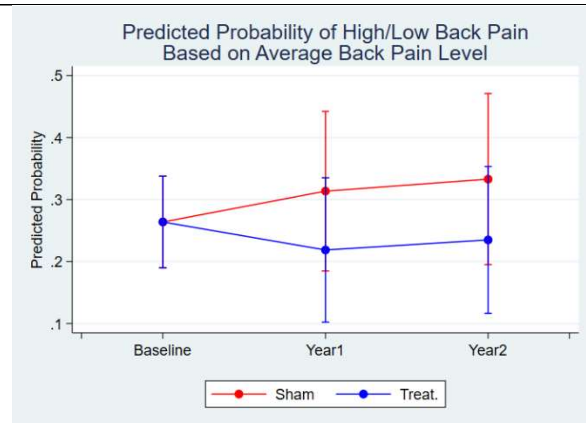


Figure 8-8. Predicted probability of medication and average back pain (high/low) by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

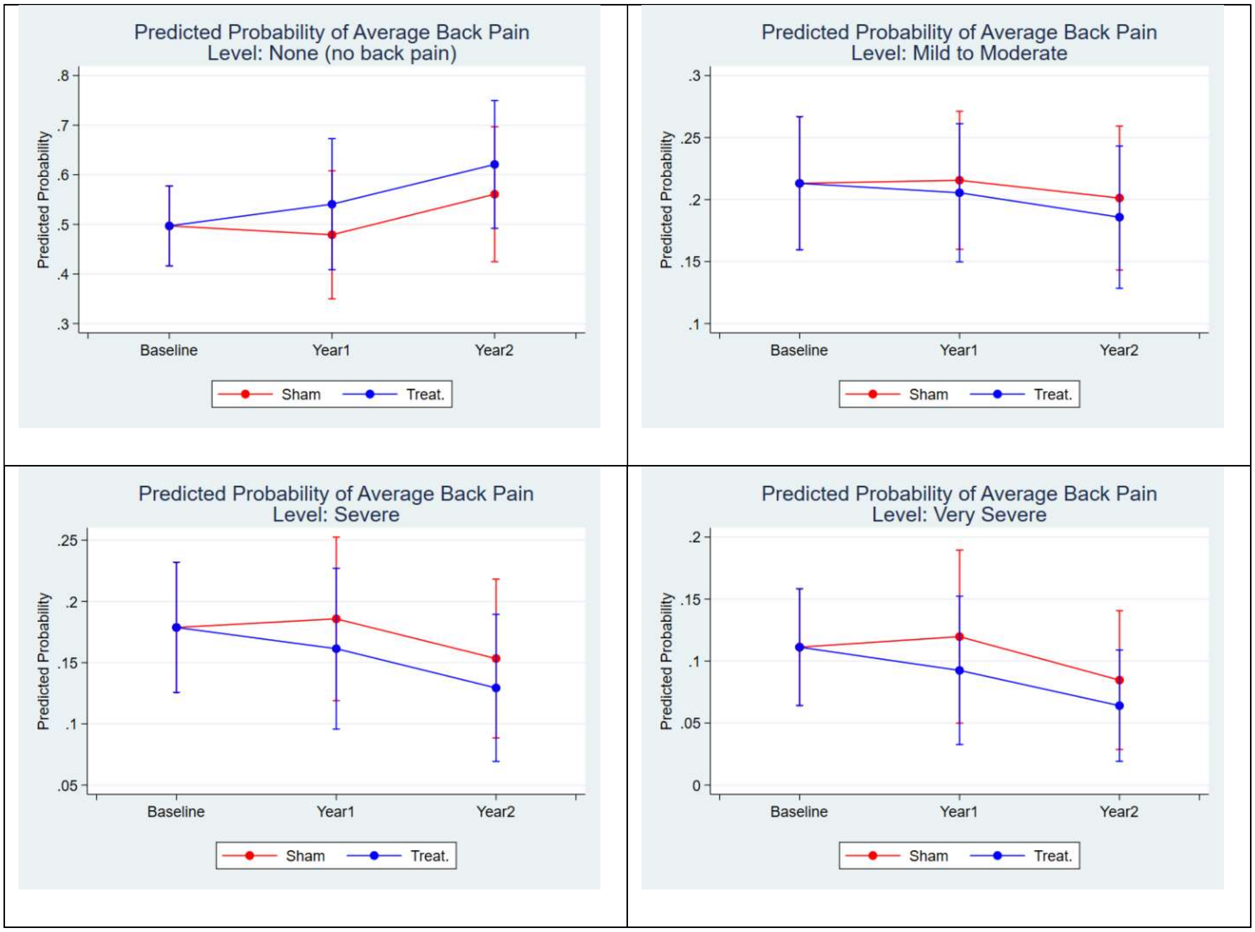


Figure 8-9. Predicted probability of average back pain (none, mild-moderate, severe, and very severe) by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

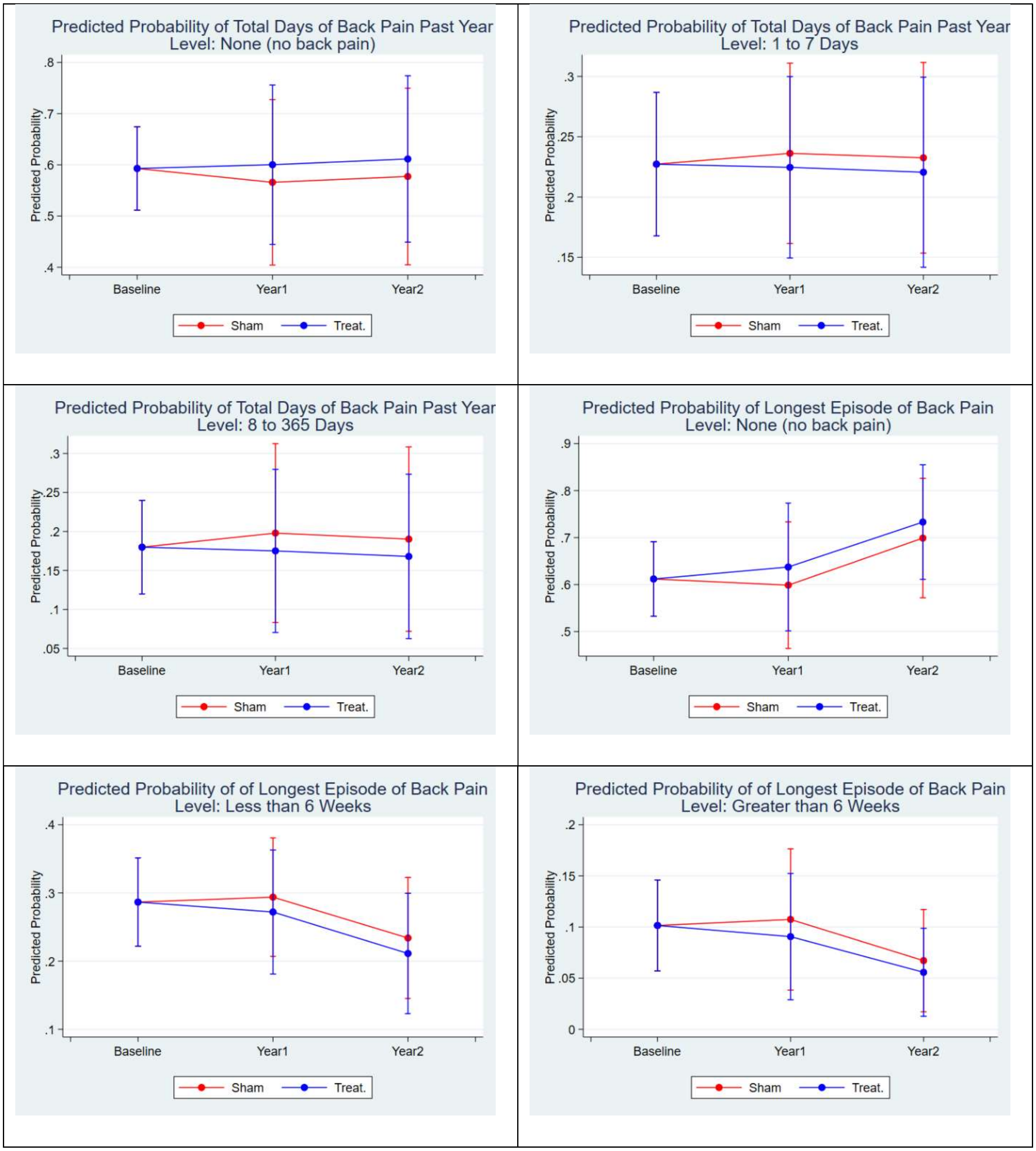


Figure 8-10. Predicted probability of total days of back pain (none, 1-7 days, 8-365 days), and longest episode of back pain (none, less than 6 weeks, 6 weeks or more) by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received

one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

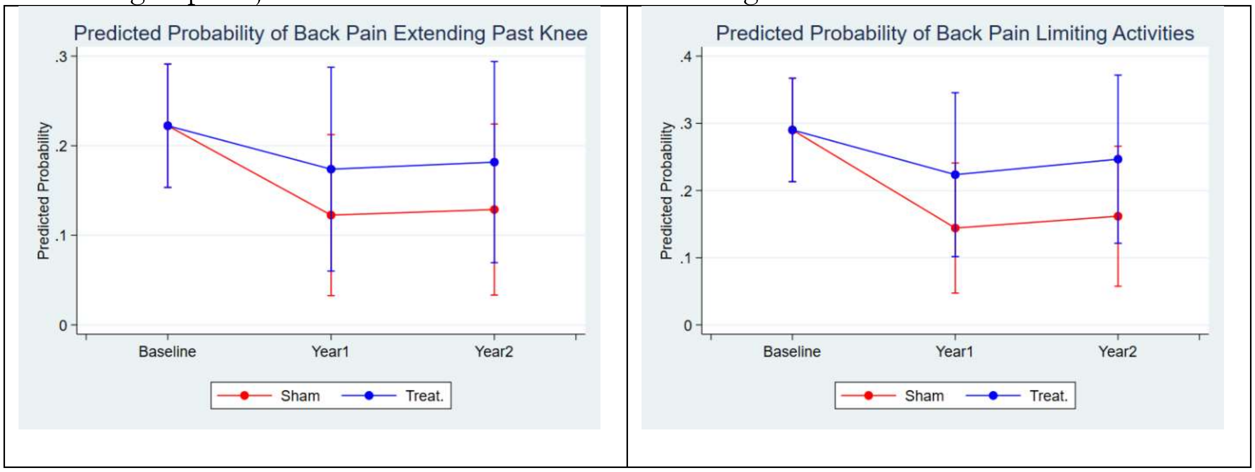


Figure 8-11. Predicted probability of sciatica and back pain that limits activities by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

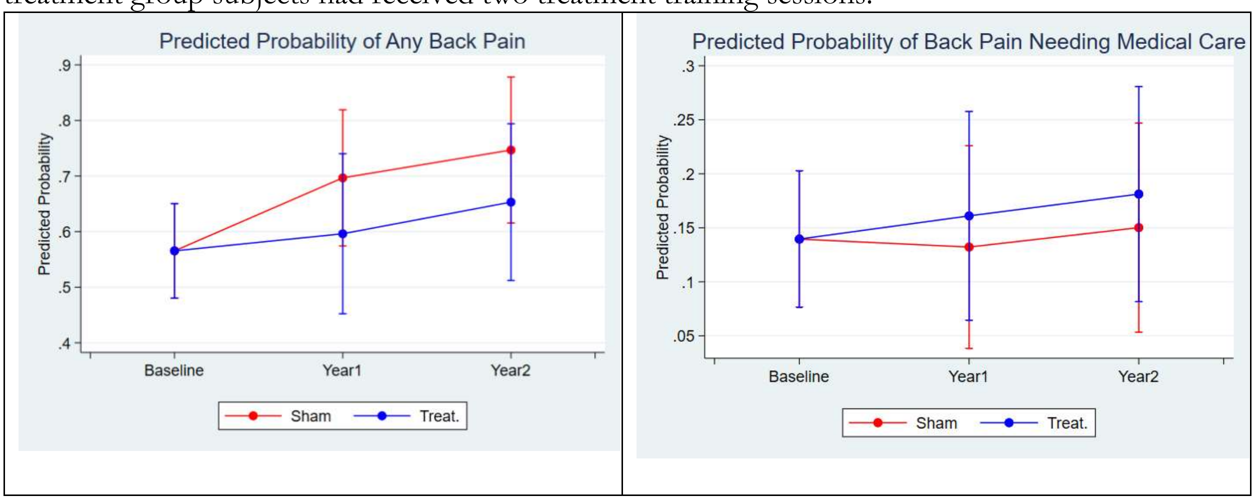


Figure 8-12. Predicted probability of any back pain and back pain needing medical care by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

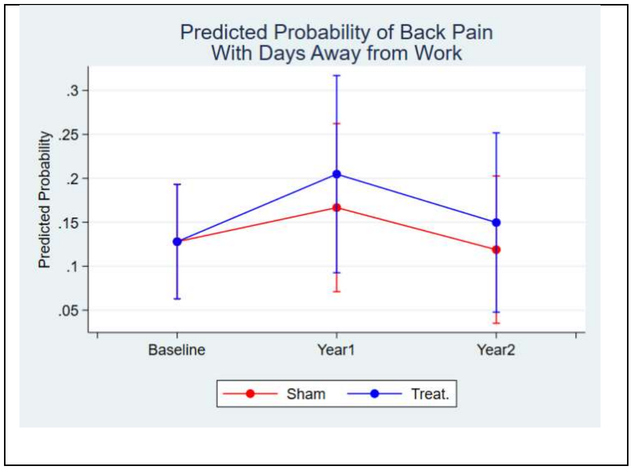


Figure 8-13. Predicted probability of back pain with days away from work by study period and group membership as defined by sham and treatment allocation at by study period and group membership as defined by sham and treatment allocation at baseline fully adjusted for sex, age, number of typical daily lifts over 25 pounds, tenure, shift, hours of sleep, language, working an additional job, and self-reported stress. Note that by study end, sham group subjects had received one sham (lifting technique) training session and one treatment (bending) training session and treatment group subjects had received two treatment training sessions.

9 DISCUSSION

9.1 CROSS-SECTIONAL BASELINE ANALYSIS DISCUSSION

Consistent with the original hypothesis, shorter wake-to-leave/work times and higher activity levels within two hours of waking were associated with higher risk for back pain and associated disability outcomes. In contrast, exercise at home after waking was mostly protective, although with smaller effect sizes and wider confidence intervals than the wake-to-leave/work times and activity levels results. Participation in the UCLA "Warm up for work" exercises produced mixed results.

When Wake-To-Leave or Wake-To-Work times were less than two hours, the odds increased by 119% or 38% for experiencing Any Back Pain, and 152% or 714% for Back Pain Radiating Past Knee, respectively. These results encompass a rather inclusive LBP measure (Any Back Pain – any indication that any level of back pain was experienced) and a much more severe LBP measure (Pain Radiating Past Knee indicating sciatica) that may be due to lumbar disc herniation. Figure 8-1 shows the association of shorter Wake-To-Leave/Work times with increased pain ratings for Current, Average, and Worst LBP.

Of all the exposure measures used in this study, the highest risks were associated with higher activity levels within the first two hours after waking, adding support for the original hypothesis. These measures had relatively narrow confidence intervals and achieved statistical significance at the p=0.1

and p=0.05 levels for many of the outcome measures. Activities during the first two hours after rising performed "Nearly All the Time" was associated with a 47-fold increased risk of experiencing very severe pain and 39 more days with LBP. Figure 8-2 shows the overall trend of higher activity associated with increased pain ratings for Current, Average, and Worst LBP.

A noteworthy exception to higher activity levels was found with Moderate activity. Moderate activity appeared to have a protective effect on back pain outcomes. When activity was grouped into three levels (None-Minimal, Moderate, Considerable-Nearly-All-the-Time) Moderate activity had 84% lower odds of high Average Pain Severity while High activity had 407% higher odds. This is consistent with the observation[30] that the health of the intervertebral disc is optimal with moderate loading, rather than low or high loading.

Mostly protective effects were found for exercise at home within two hours after waking, which is not consistent with the original hypothesis. Most exercises and "back strengthening" exercises, in particular, would be considered stressful to the spine and therefore should exacerbate disc pressure and proteoglycan fluid flow, eventually leading to back pain. Custodians reporting exercise at home within two hours of waking had half the risk of having back pain lasting a total of 1-7 days during the previous six months and 61% lower odds of having At Least One Day Away from Work Due to Back Pain. This latter disability outcome (having at least one day away from work), may be influenced by psychosocial factors that we did not control for[165]. Alternatively, both exercise and taking time off work could be considered successful and appropriate coping[166] mechanisms for dealing with heavy spine-loading work demands. Figure 8-3 shows the association of exercise at home within two hours of waking with decreased pain ratings for Current, Average, and Worst LBP.

Participating in the "Warm up for work" worksite exercises regardless of how soon the worker participated after waking had mixed results. Almost exactly half of the back pain outcomes showed decreased risks and the rest showed increased risks. A recent review[154] found that exercise reduces the risk of LBP, but this review included no blinded participants or exercise administrators and only included one workplace where the exercises were performed exclusively in the normal workplace during work time (a construction operation) and this one study[167] did not find an impact on LBP due to the exercise program.

A growing body of physical activity research[168-175] has described an occupational physical activity health paradox that leisure time physical activity appears to be beneficial to health while occupational physical activity appears to be detrimental. The reasons for this paradoxical finding are still under debate[174] but include the notion that self-paced short-term voluntary exercise respecting individual worker's capacities and needs for adequate rest may be one important determinant of potential benefits. This may help explain the greater apparent benefit of the self-paced exercise at home than for the group/instructor-paced exercises at work.

Examining the combinations of activity levels and exercise within two hours of waking (home or UCLA – see Figure 8-4) provided some insight on the potential interaction of these two dimensions. Highest activity levels were associated with increased LBP risk, but these effects were partially mitigated by exercise at least for Average and Worst pain ratings. No Activity/No Exercise was associated with slightly elevated risk compared to Minimal to Moderate Activity (with or without exercise), lending additional support for a potential protective effect of moderate activity.

The practical applications of these results are several:

1. On an individual level, back pain risk may be increased if one engages in high levels of spine-loading activities within the first few hours of waking. It would be prudent, when possible, to delay such activities for later in the day. This would include higher-back-stress exercises as well as job tasks, but moderate levels of self-directed exercise at home may be protective. One practical measure that individuals can take is to allow more time between waking and both leaving for work and arriving at work.

2. Employers may want to examine the work activities that are performed during the first part of workers' shifts. If these are heavy spine-loading activities, consideration should be given to reschedule them for later in the shift.

3. Employers should evaluate the efficacy of workplace exercise. Some warm-up may be beneficial at the start of a shift, but exercises that involve weight lifting, trunk bending, and other spine-loading activities may be counterproductive.

4. Employers can help educate workers on the potential causation mechanisms of back pain, including the vulnerability of intervertebral discs to increased disc pressure immediately after waking and the pain-inducing effects of disc fluids (proteoglycans) on the surrounding tissues or possible nerve impingement due to bulging or herniated discs. Workers with possible signs of sciatica such as LBP radiating down the leg below the knee seem to be especially vulnerable.

Employers can also remind workers of the benefits of recreational exercise, within moderation, and to not overdo exercise, especially for workers who have jobs that already involve high levels of energy expenditure and/or spine-loading tasks.

9.2 PROSPECTIVE INTERVENTION EFFECTIVENESS DISCUSSION

In this cluster-randomized cross-over controlled trial among university custodians, 1-2 sessions of bending control training led to substantial and sustained 2-year effects improving 13 out of 15 evaluated back pain incidence and severity outcomes. Most notably, the number of days with back pain per year and medication use for back pain were both cut in half and the duration of the longest back pain episode was reduced by a third. Pain severity measures decreased by 11-22%. On the other hand, the bending training increased three outcomes: any back pain by 37%, seeking medical care for treatment by 50%, and being away from work for at least one day by 22%. However, increases in any back pain reporting are generally expected to happen due to the fact that any LBP training raises awareness and recollection of LBP and is bound to increase reporting. This explanation is supported by the fact that similar increases were also observed after sham training.

Custodial work has been documented[163,164] to have high injury rates and high-risk tasks that have been associated with these high injury rates. Tasks identified as high-risk include emptying trash cans, cleaning floors, and cleaning toilets. Observations of university custodians made by the lead author of the current paper found considerable bending associated with these tasks. Occasionally, additional spine loading tasks such as moving furniture are required of custodians. After collecting their supplies (usually on a rolling cart) custodians will immediately begin these tasks. Even if a custodian in the present sample opts to participate in the warm-up exercise at the start of the shift, such exercise will include bending tasks. Consequently, control of bending and other spine-loading tasks, while primarily important in the home, for those custodians who arrive at work soon after waking, it is also important at work.

Mixed effects analysis in combination with the margins analyses afforded the opportunity to examine not only the overall effect of the intervention over the entire 2-year study period but also for each year and by subject group (sham vs treatment training group membership randomly assigned at baseline before cross-over). The latter analyses revealed a common pattern of predicted probabilities of back pain outcomes and severity scores: treatment subjects experienced relatively small decreases in pain incidence, severity, and duration in the first year after one training session at baseline and then additional and much more substantial decreases during the second year after the second training session. In contrast, the sham group experienced slight increases in these outcomes in the first year followed also by more substantial decreases in the second year. Given the partial cross-over design of this intervention trial, this pattern in the sham group is also consistent with treatment effectiveness of the bending training. Furthermore, the observation that the relative percent change in outcome measures between the year-one follow-up and the year-two follow-up (reflecting treatment, bending, training given to all subjects) was virtually identical between sham and treatment groups (data not shown). It is interesting to note that for the predicted outcomes of longest episode (four levels), longest episode (three levels), and average (four levels), the decreases in predicted probabilities for the treatment subjects one year after initial training were progressively greater for more severe back pain levels, each reaching predicted probability decreases over 40% for the most severe levels. It is also rather remarkable that such a brief training session can result in such a strong and sustained impact on back pain experience during the year following the training.

The recall period of the bassline questionnaire was only 6 months but the two follow up surveys were one year. The only variables where we adjusted for this recall difference were the total days with back pain and corresponding total days with back pain (three levels). For all the other unadjusted back pain outcome measures this would imply that the baseline would underestimate the extent of back pain experience. This seems like a reasonable assumption that within a 6-month recall timeframe subjects would have had less opportunity to experience more severe episodes of back pain than in a 12-month recall timeframe. Consequently, the impact of the treatment intervention may be underestimated. Fortunately, the study design includes the sham control group, who would reasonably be assumed to experience similar recall estimations. In the case of the adjusted total days with back pain (doubled for the baseline questionnaire) the "telescoping" [109] effect mentioned previously might artificially inflate the magnitude of decrease. However, the incident rate ratio reflects a much greater decrease in workdays lost for the treatment training (50%) than for the sham training (10%).

The three back pain measure outcomes (any back pain, receiving medical care for back pain, and at least one day away from work,) that seem to be inconsistent with the overall treatment effectiveness of the bending training might be partially due to several other reasons not mentioned above. In the common portions of the training both sham and treatment subjects heard the emphasis on how nearly everyone gets back pain. This normalization of an often hard to communicate invisible health condition may have empowered subjects to feel freer to report less severe back pain, increasing the any back pain outcome. Also, despite all trainers in both groups emphasizing that most back pain gets better without medical intervention, the emphasis on the medical aspects of back pain in the treatment training and the complexities of the impact of disc fluids on back pain may have contributed to treatment subjects being more likely to seek medical care for their back pain. The introduction of physical therapists as trainers automatically introduced their potential professional role in the treatment of LBP that many back pain sufferers are unaware of. This could have increased the propensity of LBP sufferers to more often or earlier seek medical care including a prescription for physical therapy. Finally, it's possible that these three measures may have disproportionally suffered from the recall period where the baseline was only 6 months but the follow-ups were 12 months. Agius, et al.,[190] had found better recall with more serious measures of back pain, namely absence from work because of back pain, than with less serious measures. Receiving medical care for back pain and having at least one day away from work due to back pain were not adjusted for the different recall periods.

9.3 INTERVENTION IMPACT ON BEHAVIORS DISCUSSION

The sham training was associated with decreased time between waking and leaving for and arriving for work while the treatment training was associated with increased time between waking and leaving for and arriving for work. Increasing these times is consistent with the training and the concept of giving the back more time for the proteoglycan fluids to move out of the disc before exposed to higher (e.g., work) stresses. Unfortunately, the very small magnitude (5 minutes), wide confidence intervals, and high p-values prevent any reasonable conclusion that the treatment training actually impacted these times.

Both sham and treatment training had statistically significant impacts on lowering the activity levels of subjects during the first two hours after waking. The odds of a higher activity level were decreased by 53-60% for sham training and about 40% for treatment training. While such decreased activity is consistent with the treatment training, the fact that reduced activity was also associated with the sham training (and to a greater degree) suggests that some factor, not controlled for, that was common to all subjects was associated with the reduced activity after rising.

Sham training being associated with 29% *increased* odds of doing exercise within the first two hours while treatment training was associated with 31% *decreased* odds supports the treatment training (and the underlying hypothesis that such reductions should be associated with decreases in back pain outcomes). However, the cross-sectional analysis of the baseline data revealed that exercise at home within the first two hours after rising was associated with lower ratings of current, average, and worst back pain. It's possible that the message to refrain from spine-loading that was part of the treatment training reduced exercise after waking and consequently diminished the impact of the potential for back pain to be reduced. Future analysis of these research data should control for this exercise.

Participation in UCLA's "Warm-up for Work" exercises were associated with 72% and 69% reduced odds for both sham and treatment training, respectively with statistically significant reduction for treatment training. Again, while this is consistent for the content of the treatment training, the fact that it is also true for the sham training suggest something not controlled for outside the training is more likely responsible for these reductions. Sham training was associated with 98% increased odds of participating in the UCLA exercise within 2 hours of rising and treatment training was associated with 16% decreased odds.

Both sham and treatment training were associated with 34% and 45% lower odds of higher levels of combined activity and exercise. The cross-sectional baseline analysis revealed that the highest levels of combined activity and exercise were associated with higher ratings of current, average, and worst pain. Again, while this is consistent for the content of the treatment training, the fact that it is also true for the sham training suggest something not controlled for outside the training is more likely responsible for these reductions.

With the sole exception of predicted wake to leave time, all predicted probabilities for the behaviors analyzed are very close to each other between sham and treatment subjects (with wide confidence intervals). While there are clear trends in changes by survey period, the congruence of values between sham and treatment subjects reflects that the trainings (both sham and treatment) had no meaningful impact on the behaviors measured. In the case of the predicted wake to leave time for treatment subjects, after the initial training, the predicted time between waking and leaving for work increased (9 minutes), but for sham subjects it decreased (16 minutes). The increase for treatment subjects was neither statistically significant nor meaningful and the decrease for sham subjects, while more, lacks a rationale associated with the sham training that would account for this change. Consequently, the results of the analysis of behaviors provides no evidence for an impact of this training on these behaviors. Two of the most highly-cited reviews on the impact of occupational health and safety training differed in their conclusions. One study[196] stated that, "Strong evidence was found for the effectiveness of training on worker OHS [occupational health and safety] behaviors…" but the other[197] found, "strong support for the effectiveness of training on worker OHS attitudes and beliefs and, to a lesser extent, on worker's knowledge but only medium for behavior…". However, both reviews agreed that insufficient to minimal evidence was found for training's effectiveness on health outcomes (including symptoms, injuries, and illnesses).

10 STRENGTHS AND LIMITATIONS

This the first study to examine the association between back pain outcomes and specific spine-loading activities within the first few hours after rising from sleep and the first cluster-randomized controlled workplace intervention trial designed to test the hypothesis that back pain can be reduced by training workers to control spine-loading activities in the hours immediately following rising from sleep. Specifically, this is the first study to evaluate if longer times between waking and leaving for or arriving at work, activity levels, and exercise within two hours of rising impacted an array of back pain outcomes. While many effect estimates were relatively imprecise due to the small sample size, most of the effect estimates included by the confidence intervals were aligned with the hypothesis of back pain association with spine-loading soon after waking. While findings were rather consistent, some of the detailed findings elucidated possible exceptions to this overall trend, especially for moderate activity that may be protective. In contrast to the earlier study by Snook et al.,[12,13] this analysis controlled for a wide range of potentially confounding factors.

The study design has several strengths: Randomization is extremely difficult to achieve in workplace settings. Cluster-randomization by supervisor not only achieved randomization but also limited cross-contamination of intervention content. A wide range of low back pain outcomes were examined, including both frequency and severity measures. The outcomes were not limited to one severity level of back pain but included acute, subacute, and chronic severity levels. This experiment was almost entirely blinded except for the ergonomists providing the treatment training. The use of a highly comparable sham training provided by trainers in both intervention arms who believed in the value of their training content is another clear strength the study's design.

Participation rates in the study were lower than anticipated. The voluntary nature of both participation and answering specific questions was emphasized to subjects and impacted participation rates and resulted in missing answers to some questionnaire items (e.g., dependent care-taking responsibilities) that thus could not be controlled for in our analyses. The voluntary nature of answering the questionnaires also significantly impacted participation in follow-up questionnaires at the year-one and year-two follow ups. The percent consented subject dropout between the baseline questionnaire and the year-one follow-up questionnaire was large but similar for the sham (42%) and treatment (39%) groups. By the year-two follow-up survey the net percent consented subject dropout was 27% for sham subjects and 29% for treatment subjects. These percentages suggest no differential loss on follow-up and together with randomization and comparable sham training make selection bias highly unlikely. The sham training and partial-crossover design allowed all subjects to receive the treatment training. Not only did this fulfill an ethical obligation to provide all workers with a potentially beneficial intervention, but it also increased the number of observations available to estimate treatment training effects in mixed effect models. The choice of mixed models increased statistical power compared to traditional comparisons of change scores between treatment and control groups.

No follow-up was done with non-subjects, however, repeated attempts at both follow-up points were made to get as many subjects as possible to complete the questionnaires. Fortunately, custodial administration had made the decision (independently from researchers) to require all custodians to receive the training sessions regardless of their status as a study subject or their completion/non-completion of a questionnaire. This had the benefit that those who did not complete the year-one follow-up questionnaire but did complete the year-two follow-up questionnaire had, in fact, received the treatment training.

The majority (77%) of the workers in this study were night shift workers. Typical sleep patterns of night shift workers differ from day workers. Night shift workers tend to go to bed after returning home in the morning and then get up and stay up till they leave for work, making the wake-to-work time longer. In the present study, even though the mean sleep durations of day- and night-shift workers were comparable (6.8 and 6.5, respectively), night-shift workers had a mean wake-to-work time of 5.6 hours compared to day-shift workers with only 0.9 hours. This means night shift workers were already up for a long time by the time they arrived at work. This can lead to greater fatigue on the job and therefore higher reporting of back pain. Consequently, any benefit to longer wake-to-work time (consistent with the hypothesis of this study) may have been somewhat muted by increased fatigue that could have increased the risk of back pain outcomes in this large subgroup of night-shift workers.

Other than the distinction between exercise at home and exercise at work, survey questions did not allow for any gradation of exercise by intensity, duration, or nature of the exercise (stretching, warm-up, aerobic, anerobic, etc.). It may have been that more intense levels of exercise were reflected in higher levels of reported overall activity, but this cannot be determined with our data. What is clear is that high levels of activity within 2 hours of rising (with or without exercise) were associated with more intense levels of pain. If respondents had been asked to rate their level of exercise intensity or categorize the kinds of exercise at home, there may have been stronger associations with either increased or decreased back pain outcomes. Furthermore, this study did not examine exercise and/or activity levels *after* work. It is unclear what impact this may have had on the results.

All pain, time, exercise, and activity levels in this study were self-reported. Data collection with wearable sensors was not a viable consideration at the time this study was initiated, but could provide more objective data for future similar studies. Objective measures of pain have not yet been developed and self-report is still the gold standard for assessing pain. The NRS Pain scale for pain severity assessment has been validated[176,177] and used in many studies[178] and our array of complementary pain and disability measures have excellent face validity. On the other hand, the use of one of the more widely used and validated musculoskeletal pain or disability instruments could have provided extra confidence in the validity of outcome measures and improved direct comparability to other back pain research.

The nature of a cross-sectional analysis leaves the question of causation unanswered. Although the associations between high activity after waking and back pain outcomes was strong, it is possible that such activity was in response to high levels of back pain rather than vice versa. The counterargument to this is that back pain (especially chronic back pain) has been associated with fear avoidance of activity rather than engaging in higher levels of activity.[179,180]

All these design advantages did not fully compensate for low participation and high drop-out rates and consequently none of the prospective estimated effects reached statistical significance at the 0.05 alpha level. However, some prospective effects reached statistical significance at the 0.10 level and the larger part of the range of confidence intervals is clearly more compatible with effectiveness of the treatment than with no effect. This interpretation of the results is in accordance with the recent guidelines of the American Statistical Association emphasizing effect estimation over statistical significance testing.[191]

Relative imprecise effect measures may also be due to misclassification of outcomes and other variables. All pain, time, exercise, and activity levels in this study were self-reported. Data collection with wearable sensors was not a viable consideration at the time this study was initiated, but could provide more objective data for future similar studies. Objective measures of pain are not available and self-report is still the gold standard for assessing pain. The NRS Pain scale for pain severity assessment has been validated[176,177,192] and used in many studies[178] and our array of complementary pain and disability measures have excellent face validity. On the other hand, the use of one of the more widely used and validated standard musculoskeletal pain or disability instruments could have provided extra confidence in the validity of outcome measures and improved direct comparability to other back pain research. Our choice to use Snook's questionnaire items instead was in the service of repeating his study with similar measures and by the necessity to keep the size of the questionnaire relatively short in order to be acceptable for this worksite.

Research tends to indicate a favorable recall for back pain resulting in days away from work for 6- and 12-month recall periods, but less so for longer periods and for other-than-back-pain reasons. Agius, et al., found that 12-month recall by coal-mine workers about absence from work because of back pain had good agreement with company records (82% sensitivity and 84% specificity). Burdorf et al., examined 6-month recall of prevalence of back pain resulting in absence from work compared to company records and found high sensitivity (88%) and specificity (97%). Fredriksson, et al.,[193] examined 4-year recall of sick leave data for musculoskeletal "diseases" and found high specificity but low sensitivity and they concluded, "…such data will underestimate the prevalence of sick leave and should not be used for surveys of morbidity." Van Poppel, et al.,[194] compared 6-, 9-, and 12-month questionnaire responses recalling sick leave occurrence and severity with company records. They found the questionnaires to have only 55% sensitivity and 83% specificity for detecting an episode of sick leave and "there was little agreement on the duration of the episode between questionnaire data and data in the company records." Ferrie, et al.,[195] found "relatively good" agreement between self-reported and company-recorded sickness absence days, but found that the agreement of the number of days recalled as absent decreased as the total number of recorded days increased. Dalziel,[109] et al., looking at 2-week, 6-month, and 12-month recall of doctor visits found the 12-monnth period to be most accurate with 2-week and 6-month recall including longer recall times than requested, suggesting the "telescoping" effect mentioned previously. Despite the favorable sensitivity and specificity described in the literature for both 6- and 12-month recall, it is not a 100% accurate way to capture frequency and severity measures.

In addition, in our study recall periods differed between baseline questionnaire (6 months) and follow-up questionnaires (12 months). This inconsistency was only noticed in hindsight when it was not possible to correct the baseline questionnaire and the longer follow-up recall was chosen to cover change over the entire period between intervention and follow-up and because shorter recall periods may "telescope" and include events past the requested recall period. [109] As stated earlier, if this telescoping effect was present, then the doubling of the baseline reporting of total days with back pain may have artificially inflated the decrease in the number of days with back pain observed during follow up, but the greater decreases noted for treatment versus sham mutes this concern. Alternative frequent repeat back pain measures such as weekly diaries were not chosen in order to keep the burden of participation to a minimum.

11 CONCLUSIONS

In the cross-sectional evaluation of the baseline questionnaire, higher levels of bending, sitting, and lifting (objects over 10 pounds) during the first two hours after rising from sleep were associated with adverse back pain outcomes while moderate levels of such spine-loading activities and exercise within the first few hours after waking was associated with less back pain risk. Moderate activity appeared to have a protective effect albeit of modest size compared to the detrimental effects of high levels of activity. Longer wake-to-work time and more time between waking and leaving for work were associated with reduced back pain risk. These results are generally consistent with the original hypothesis that spine loading immediately after rising from sleep and being expected to amplify diurnal proteoglycan movement from intervertebral discs or increases disc bulging can cause or exacerbates low back pain, at least in custodial workers who regularly have to perform spine-loading tasks during work.

Wu, et al. 1, note, "Globally, LBP is the leading global cause of YLDs [Years Lived with Disability]. Greater attention is urgently needed to mitigate this increasing burden and the impact it is having on health and social systems." This study was undertaken to give attention to an underexplored aspect of back pain causation and potential control. In the two-year prospective intervention study of a training program to reduce spine loading after waking, university custodians experienced substantial and highly consistent reductions in a wide range of back pain outcomes. The largest reductions of about 50% were seen for the number of total days of back pain and medication use for back pain (47% reduced odds) and sustained over at least 12 months of follow-up.

Overall, the findings support earlier findings by Snook et al.[12,13] and are consistent with the hypothesis that reduction of spine-loading and trunk bending in the early hours after raising from sleep may help reduce the incidence, duration, and severity of low back pain episodes among custodial workers.

These promising findings warrant confirmation and generalization in other and larger worker and population samples.

12 SUMMARY

This prospective cluster-randomized controlled training intervention to reduce back pain through control of spine-loading soon after waking demonstrated trends of both cross-sectional association and prospective impact on back pain outcomes that support the hypothesis that decreased time between waking and leaving for or arriving at work and spine loading activities within the first few hours after waking contribute to back pain. Many kinds of exercise would be considered spine-loading. This experiment did not examine the *kind* of exercise performed, but found that self-reported exercise at home within two hours of rising from sleep, and to a lesser degree exercise at work (UCLA "warm up" exercises) had a slightly protective effect on back pain outcomes. Higher levels of bending, sitting, and lifting (objects over 10 pounds) during the first two hours after rising from sleep were associated with adverse back pain outcomes while moderate levels of such spine-loading activities and exercise within the first few hours after waking was associated with less back pain risk. Moderate activity appeared to have a protective effect albeit of modest size compared to the detrimental effects of high levels of activity. Longer wake-to-work time and more time between waking and leaving for work were associated with reduced back pain risk. When time between rising and leaving for or arriving at work were less than two hours, LBP risk increased by 119% or 38%, respectively, and sciatica risk increased 152% or 714%, respectively. Bending, sitting, and lifting (objects over 10 pounds) during the first two hours after rising performed "Nearly All the Time" were associated with a 47-fold increased risk of very severe pain and 39 more days with LBP.

A pattern of greater reduction in odds and incident rate ratios for most back pain measures for treatment subjects as compared to sham subjects. Likewise, reductions in predicted probabilities, predicted scores, and predicted counts of the back pain outcomes were seen to a greater degree with treatment subjects than sham subjects, especially between the baseline training and the one-year follow-up. Consistent with the experimental design and intervention goal, similar reductions were found with all subjects (sham and treatment) after all subjects had received the treatment training. The greatest decreases for treatment training were for total days of back pain (50% reduction of incident rate ratio) and medication use for back pain (47% reduced odds).

13 APPENDIX I - QUESTIONNAIRE WITH ANNOTATED SOURCES/REFERENCES

(On Next Page)

A1. YOUR NAME:____

A2. EMPLOYEE ID#:_________________________________

A3. DEPARTMENT: ____

A4. JOB TITLE: ____

A5. TODAY'S DATE [MM/DD/YYYY] ______________________________

<u>Please circle the number on the right for each of your answers for each question.</u>

1. Within the last 6 months have you taken any medicine (including over-the-counter medication) to reduce back pain? [Adapted from Snook, et al., 1998[12]]

YES...................................... 1

NO....................................... 2

2. Within the last 6 months have you had back pain that made it hard or kept you from doing any of your usual work, school or housework activities? [Adapted from Snook, et al., 1998[12]]

YES...................................... 1

NO....................................... 2

3. Within the last 6 months have you seen a doctor, chiropractor, physical therapist or other health care provider for back pain? [loosely adapted from Snook, et al., 1998[12] and Agius, et al., 1994[190]]

YES...................................... 1

NO....................................... 2

4. Within the last 6 months have you had back pain that kept you away from work at least one day? [Adapted from Snook, et al., 1998[12]]

YES...................................... 1

NO....................................... 2

5. Within the last 6 months have you had a workers' compensation claim for back pain? [Adapted from Agius, et al., 1994[190]]

YES...................................... 1

NO....................................... 2

6. Within the last 6 months the longest episode of back pain you had lasted: [Adapted from Agius, et al., 1994[190] and Higuchi, et al., 2010[198]]

No back pain in last 6 months...................... 1

Less than 6 weeks 2

Six to 12 weeks..................................... 3

Twelve weeks or more 4

7. Within the last 6 months how many total days have you had back pain?____ [Adapted from Agius, et al., 1994[190]]

8. Within the last 6 months have you had back pain that includes pain down your leg past your knee? [Adapted from Agius, et al., 1994[190]]

YES...................................... 1

NO....................................... 2

9. Within the last 6 months how bad was your **worst** back pain? [Adapted from Higuchi, et al., 2010[198]]

0 10

No pain Most severe pain

10. Withi n the last 6 months how bad was your **average** back pain? [Adapted from Higuchi, et al., 2010[198]]

0 10

No pain Most severe pain

11. Right now, how bad is your back pain? [Adapted from Higuchi, et al., 2010[198]]

0 10

No pain Most severe pain

12. How much of the time during the past week have you felt under stress? [Verbatim from the Back Disability Risk Questionnaire (BDRQ).[117]]

None or a little of the time........................ 1

Some or a good bit of the time...................... 2

Most or all of the time............................. 3

13. On a typical work day, what time do you usually get out of bed after sleeping?_____________________ am pm

(circle am or pm)

14. On a typical work day, when do you first (after waking from sleep) leave home for work ("first" means your UCLA job or another job)?_______________________ am pm

(circle am or pm)

15. On average, how many hours of sleep do you get in a 24-hour period?____ [Verbatim from Canfield, et al., 2003.[199]]

16. Do you have more than one job (other than working for UCLA)? [Adapted from Abdukadir, 1992.[200]]

YES...................................... 1

NO....................................... 2

17. On a typical work day, do you exercise or do any back stretching exercises within the first two hours after waking up?

YES...................................... 1

NO....................................... 2

18. Do you do the exercises during the UCLA "Warm-up for work" that is given at the beginning of your shift?

YES...................................... 1

NO....................................... 2

19. On a typical work day, within the first two hours after getting out of bed, how much bending, sitting, and lifting (objects over 10 pounds) do you do? [Adapted from Agius, et al., 1994[190]]

None.. 1

Minimal (sit on toilet, sit to put
on socks and shoes)............................ 2

Moderate (up to half the time spent
bending, sitting or lifting).................. 3

Considerable (up to ¾ of the time spent bending, sitting or lifting).. 4

Nearly all the time is spent bending, sitting or lifting)........................5

20. On a typical work day, how many times do you lift something heavy (over 25 pounds)?________________________

21. When you lift objects, do you bend your knees and keep your back straight?

YES.. 1

NO... 2

22. Do you believe back pain gets better on its own or do you think you need professional help to get better? [Adapted from Werner, et al., 2005.[88]]

Gets better on its own.................... 1

Need professional help to get better...... 2

23. How many years of school did you complete and receive credit for?_________________________ [From Aday and Cornelius, 2006.[110]]

24. Are you currently: [From Aday and Cornelius, 2006.[110]]

Married............................ 1

Living with a partner as if married.. 2

Widowed............................ 3

Divorced........................... 4

Separated.......................... 5

Never Married........................ 6

25. How old are you?______________________________________ [From Aday and Cornelius, 2006.[110]]

26. How many children 5 years old or younger do you care for at least weekly?_________________ [Adapted from Aday and Cornelius, 2006.[110]]

27. Choose the income range that contains your approximate annual household income during 2011 before taxes: [Adapted from income categories based on distributions published by the US Census Bureau (http://factfinder.census.gov/servlet/STTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2008_3YR_G00_S1901&-ds_name=ACS_2008_3YR_G00_).]

A. Less than $10,000............... 01

B. $10,000 to $14,999.............. 02

C. $15,000 to $24,999.............. 03

D. $25,000 to $34,999.............. 04

E. $35,000 to $49,999.............. 05

F. $50,000 to $74,999.............. 06

G. $75,000 to $99,999.............. 07

H. $100,000 to $149,999............ 08

I. $150,000 to $199,999............ 09

J. $200,000 or more................ 10

28. SEX

MALE................................ 1

FEMALE.............................. 2

29. Thank-you very much for your participation! Do you have any questions or comments you would like to add?

15 APPENDIX II – BACK PAIN OUTCOMES

(On Next Page)

Back pain outcomes:

1. . The first ten out of 11 low back pain (LBP) questions listed below (including their variable names) started "Within the last 6 months …" followed by: "… have you taken any medicine (including over-the-counter medication) to reduce back pain?"; variable "Medication for Back Pain (yes/no)
2. "… have you had back pain that made it hard or kept you from doing any of your usual work, school or housework activities?"("Activity Limitations (yes/no)
3. "Within the last 6 months have you seen a doctor, chiropractor, physical therapist or other health care provider for back pain?"; variable called "Health Care Provider Visit" with "Yes" or "No" response choices. (Question 3)
4. "Within the last 6 months have you had back pain that kept you away from work at least one day?"; variable called "At Least One Day Away from Work Due to Back Pain" with "Yes" or "No" response choices. (Question 4)
5. "Within the last 6 months have you had a workers' compensation claim for back pain?"; variable called "Workers' Compensation Claim" with "Yes" or "No" response choices. (Question 5)
6. "Within the last 6 months the longest episode of back pain you had lasted:"; variable called "Longest Episode of Back Pain" with response choices of "No back pain in the last 6 months" (referred to as "None"), "Less than 6 weeks" (referred to as "Up to 6 weeks"), "Six to 12 weeks" (referred to as "6 to 12 weeks"), and "Twelve weeks or more" (referred to as "12 weeks or longer"). (Question 6)
7. "Within the last 6 months how many total days have you had back pain?" variable called "Total Days with Back Pain" with any number being a valid response. (Question 7)
8. "Within the last 6 months have you had back pain that includes pain down your leg past your knee?"; variable called "Back Pain Radiating Past Knee" with "Yes" or "No" response choices. (Question 8)
9. "Within the last 6 months how bad was your worst back pain?"; variable called "Worst Pain Severity" with responses of 0 to 10 on a numeric rating scale for pain (NRS Pain). (Question 9)
10. "Within the last 6 months how bad was your average back pain?"; variable called "Average Pain Severity" with responses of 0 to 10 on an NRS Pain. (Question 10)
11. "Right now, how bad is your back pain?"; variable called "Current Pain Severity" with responses of 0 to 10 on an NRS Pain. (Question 11)

The two highest answer categories of questions 6 were collapsed into "6 weeks or more", and average pain severity scores of question 10 were grouped into a binary (score 0-3 = low, 4-10 = high) and a quaternary measure (scores 0=none, 1-3=mild-moderate, 4-6=severe, 7-10=very severe).
A dichotomous overall outcome measure reflecting "Any Back Pain" within the last 6 months was created based on any affirmative response to Questions 1-5 and 8, or any non-zero response to questions 7 and 9-11, or any responses to Question 6 other than "No back pain in the last 6 months.".

16 APPENDIX III – ACTIVITY-EXERCISE CATEGORIES

(On Next Page)

The seven levels of the combined variable Activity & Exercise (Home or UCLA within 2 hours of waking) are:

1. <u>"No Activity/No Exercise"</u> – respondents answering "None" for activity within 2 hours after waking and no exercise within 2 hours after waking (home or UCLA). Three respondents with missing activity data but who did not have exercise with 2 hours after waking were also included in this level.

2. <u>"Minimal Activity/Minimal Exercise"</u> – respondents answering "Minimal" for activity within 2 hours after waking and no exercise within 2 hours after waking (home or UCLA) or respondents answering "None" for activity within 2 hours after waking and exercise within 2 hours after waking (home or UCLA). One respondent who had missing exercise data but minimal activity was also included in this level.

3. <u>"Minimal Activity/Exercise"</u> – respondents answering "Minimal" for activity within 2 hours after waking and exercise within 2 hours after waking (home or UCLA).

4. <u>"Moderate Activity/No Exercise"</u> – respondents answering "Moderate" for activity within 2 hours after waking and no exercise within 2 hours after waking (home or UCLA).

5. <u>"Moderate Activity/Exercise"</u> – respondents answering "Moderate" for activity within 2 hours after waking and exercise within 2 hours after waking (home or UCLA). Six respondents with missing activity data but with exercise within 2 hours after waking (home or UCLA) were also included in this level.

6. <u>"High Activity/No Exercise"</u> - respondents answering "Considerable" or "Nearly all the time" for activity within 2 hours after waking and no exercise within 2 hours after waking (home or UCLA). One respondent with missing exercise data but "Nearly all the time" activity was also included in this level.

7. <u>"High Activity/Exercise"</u> - respondents answering "Considerable" or "Nearly all the time" for activity within 2 hours after waking and exercise within 2 hours after waking (home or UCLA).

Rationale for levels of combined variable Activity & Exercise (Home or UCLA w/in 2hrs of waking): Based on the hypothesis, the highest risk would be when BOTH activity (at a high level – Considerable or Nearly all the time) and exercise were being done within 2hrs of waking. So these two levels were created:

- "No Activity/ No Exercise" - No activity and no exercise. There were no subjects who responded with None activity but were missing exercise, but if there had been these would have been coded as in this level as well since indicating None activity without answering the exercise question probably reflects considering no exercise as no activity. Similarly, for the three subjects who responded with No exercise but did not answer the activity question, these were coded as in this level since indicating No exercise without answering the activity question probably reflects considering no activity as no exercise either.

- "High Activity/Exercise" - Only those subjects who had BOTH high activity (Considerable or Nearly all the time) AND exercise w/in 2hrs of waking.

The remaining levels were progressions of activity and exercise levels:

- "Minimal Activity/Minimal Exercise" was coded for those subjects who had minimal activity and no exercise OR no activity and exercise. The one subject who had minimal activity with missing exercise was also included. The rationale here is that anyone who exercises that considers that exercise to NOT be activity could be considered to be in a similar category as someone who has minimal activity but does not exercise.
- "Minimal Activity/Exercise" was coded for those subjects with BOTH minimal activity and exercise w/in 2hrs of waking.
- "Moderate Activity/No Exercise" was coded for those subjects with moderate activity and either no or missing exercise. (In this case there were no moderate activity and missing exercise subjects.)
- "Moderate Activity/Exercise" was coded for those subjects with BOTH moderate activity and exercise w/in 2hrs of waking. Six subjects had missing activity data but reported exercise w/in 2hrs of waking. These 6 subjects all had exercise at home within 2hrs of waking and 2 of them also had UCLA warm up exercise within 2hrs of waking. Since most subjects reporting exercise (home or UCLA) within 2hrs of waking categorize their activity level as moderate, these 6 subjects were included in this level.
- "High Activity/No Exercise" was coded for those subjects who had high activity (Considerable of Nearly all the time) but did not have exercise w/in 2hrs of waking. This included subjects who had missing values for the exercise based on similar rationale described above.

17 APPENDIX IV – TESTS TO DETERMINE DIFFERENCES IN MEASURES AT BASELINE

(On Next Page)

```
log:  C:\Users\georg\Desktop\Newest Analysis and Papers 210929\Log, tests to determine
differences at baseline 211114a.smcl
  log type:  smcl

. * Do file to determine differences between groups at baseline
.
. ttest age if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      77    48.74026    1.063018    9.327947    46.62308    50.85744
 Bending |      80     46.2375    1.154551    10.32662    43.93942    48.53558
---------+--------------------------------------------------------------------
Combined |     157    47.46497     .789938    9.897895    45.90461    49.02532
---------+--------------------------------------------------------------------
    diff |             2.50276    1.572456               -.6034492    5.608969
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   1.5916
H0: diff = 0                                     Degrees of freedom =      155

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9432         Pr(|T| > |t|) = 0.1135          Pr(T > t) = 0.0568

.
. ttest sleep if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      71    6.433099    .1838525    1.549169    6.066416    6.799781
 Bending |      74     6.72973     .201792    1.735881    6.327559    7.131901
---------+--------------------------------------------------------------------
Combined |     145    6.584483    .1368699    1.648131    6.313949    6.855016
---------+--------------------------------------------------------------------
    diff |           -.2966311     .273632               -.8375173     .244255
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =  -1.0841
H0: diff = 0                                     Degrees of freedom =      143

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1401         Pr(|T| > |t|) = 0.2802          Pr(T > t) = 0.8599

.
. tab group sex if survey==0, chi2

Interventi |
   on-Sham |          Sex
     Group |      Male     Female |     Total
-----------+----------------------+----------
   Lifting |        48         29 |        77
   Bending |        40         40 |        80
-----------+----------------------+----------
     Total |        88         69 |       157
```

```
          Pearson chi2(1) =   2.4245   Pr = 0.119
. tab group language if survey==0, chi2

Interventi | Language 1(English),
   on-Sham |      2(Spanish)
     Group |   English    Spanish |     Total
-----------+----------------------+----------
   Lifting |        47         30 |        77 
   Bending |        52         28 |        80 
-----------+----------------------+----------
     Total |        99         58 |       157 

          Pearson chi2(1) =   0.2643   Pr = 0.607

. 
. tab group stress if survey==0, chi2

Interventi |
   on-Sham |  Stress level during past week
     Group |      None       Some       Most |     Total
-----------+---------------------------------+----------
   Lifting |        46         16          6 |        68 
   Bending |        43         25          6 |        74 
-----------+---------------------------------+----------
     Total |        89         41         12 |       142 

          Pearson chi2(2) =   1.8265   Pr = 0.401

. 
. tab group shift if survey==0, chi2

Interventi |
   on-Sham | Shift (Day or Night)
     Group | Shift1-Da  Shift2-Ni |     Total
-----------+----------------------+----------
   Lifting |        16         61 |        77 
   Bending |        19         61 |        80 
-----------+----------------------+----------
     Total |        35        122 |       157 

          Pearson chi2(1) =   0.1999   Pr = 0.655

. 
. ttest lifts if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      60    6.091667    1.224716    9.486606    3.641016    8.542317
 Bending |      72    4.916667    .8033941    6.817025    3.314744    6.518589
---------+--------------------------------------------------------------------
Combined |     132    5.450758    .7074514    8.127998     4.05125    6.850265
---------+--------------------------------------------------------------------
    diff |               1.175    1.422512               -1.63927     3.98927
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   0.8260
H0: diff = 0                                     Degrees of freedom =      130
```

```
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7948         Pr(|T| > |t|) = 0.4103          Pr(T > t) = 0.2052
. tab group otherjob if survey==0, chi2

Interventi |  Have More than UCLA
   on-Sham |          Job
     Group |         No        Yes |     Total
-----------+----------------------+----------
   Lifting |        64          8 |        72 
   Bending |        72          7 |        79 
-----------+----------------------+----------
     Total |       136         15 |       151 

          Pearson chi2(1) =   0.2132   Pr = 0.644

.
. ttest tenure if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      77    8.095855    .7610986    6.678613    6.579996    9.611714
 Bending |      80    8.725942    .8772028     7.84594    6.979913    10.47197
---------+--------------------------------------------------------------------
Combined |     157    8.416918    .5810376    7.280381    7.269202    9.564635
---------+--------------------------------------------------------------------
    diff |           -.630087    1.164932               -2.931278    1.671105
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =  -0.5409
H0: diff = 0                                     Degrees of freedom =      155

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.2947         Pr(|T| > |t|) = 0.5894          Pr(T > t) = 0.7053

.
. ttest wake2leave if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      71    4.605634    .3244238    2.733644    3.958591    5.252677
 Bending |      75    4.464444    .3247744    2.812629    3.817317    5.111572
---------+--------------------------------------------------------------------
Combined |     146    4.533105    .2289023    2.765837    4.080689    4.985521
---------+--------------------------------------------------------------------
    diff |           .1411894    .4594133               -.7668756    1.049254
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   0.3073
H0: diff = 0                                     Degrees of freedom =      144

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6205         Pr(|T| > |t|) = 0.7590          Pr(T > t) = 0.3795

.
```

```
. ttest wake2work if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      71    5.903286    .3373023    2.842159    5.230558    6.576015
 Bending |      75    5.512222    .3637259    3.149959    4.787483    6.236962
---------+--------------------------------------------------------------------
Combined |     146    5.702397    .2483079    3.000315    5.211627    6.193168
---------+--------------------------------------------------------------------
    diff |            .3910642    .4974579               -.5921988    1.374327
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   0.7861
H0: diff = 0                                     Degrees of freedom =      144

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7835         Pr(|T| > |t|) = 0.4331          Pr(T > t) = 0.2165

.
. tab group activity if survey==0, chi2

Interventi |
   on-Sham |           Activity Level within 2hrs rising
     Group |      None    Minimal   Moderate  Considera     Always |     Total
-----------+-------------------------------------------------------+----------
   Lifting |        22         16         20          7          4 |        69
   Bending |        25         16         14         11          6 |        72
-----------+-------------------------------------------------------+----------
     Total |        47         32         34         18         10 |       141

          Pearson chi2(4) =   2.4765   Pr = 0.649

.
. tab group exer1st2hrs if survey==0, chi2

Interventi |   Exercise at home
   on-Sham |  within 2hrs rising
     Group |        No        Yes |     Total
-----------+----------------------+----------
   Lifting |        36         36 |        72
   Bending |        39         39 |        78
-----------+----------------------+----------
     Total |        75         75 |       150

          Pearson chi2(1) =   0.0000   Pr = 1.000

.
. tab group any if survey==0, chi2

Interventi |
   on-Sham |     Any Back Pain
     Group |        No        Yes |     Total
-----------+----------------------+----------
   Lifting |        32         45 |        77
   Bending |        35         45 |        80
```

```
-----------+----------------------+----------
     Total |        67         90 |       157

          Pearson chi2(1) =   0.0770   Pr = 0.781
. tab group sci if survey==0, chi2

Interventi |  Back Pain past the
   on-Sham |    knee (Sciatica)
     Group |        No        Yes |     Total
-----------+----------------------+----------
   Lifting |        58         19 |        77 
   Bending |        62         18 |        80 
-----------+----------------------+----------
     Total |       120         37 |       157 

          Pearson chi2(1) =   0.1031   Pr = 0.748

.
. ttest ave if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      76    2.355263    .3307111    2.883072    1.696453    3.014073
 Bending |      79    2.126582    .3075207    2.733304    1.514356    2.738809
---------+--------------------------------------------------------------------
Combined |     155     2.23871    .2249766    2.800936    1.794271    2.683148
---------+--------------------------------------------------------------------
    diff |            .2286809    .4511272               -.6625617    1.119923
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   0.5069
H0: diff = 0                                     Degrees of freedom =      153

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6935         Pr(|T| > |t|) = 0.6129          Pr(T > t) = 0.3065

.
. ttest worst if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      76    2.776316    .3900511    3.400387    1.999294    3.553337
 Bending |      79    2.518987    .3520519    3.129106    1.818106    3.219869
---------+--------------------------------------------------------------------
Combined |     155    2.645161    .2615961    3.256845    2.128381    3.161941
---------+--------------------------------------------------------------------
    diff |            .2573284    .5245851               -.7790368    1.293694
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   0.4905
H0: diff = 0                                     Degrees of freedom =      153

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6878         Pr(|T| > |t|) = 0.6245          Pr(T > t) = 0.3122

.
```

```
. ttest now if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      76    1.065789    .2480348    2.162317    .5716789      1.5599
 Bending |      79    1.101266    .2325332    2.066801    .6383277    1.564204
---------+--------------------------------------------------------------------
Combined |     155    1.083871    .1692673    2.107361    .7494854    1.418257
---------+--------------------------------------------------------------------
    diff |           -.0354763    .3396907               -.7065661    .6356134
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =  -0.1044
H0: diff = 0                                     Degrees of freedom =      153

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.4585         Pr(|T| > |t|) = 0.9170          Pr(T > t) = 0.5415

.
. ttest td if survey==0, by(group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
 Lifting |      74    15.66216    4.929577    42.40583    5.837529     25.4868
 Bending |      78    7.858974     3.28402    29.00368    1.319654    14.39829
---------+--------------------------------------------------------------------
Combined |     152    11.65789     2.93978    36.24404    5.849481    17.46631
---------+--------------------------------------------------------------------
    diff |            7.803188    5.866675               -3.788806    19.39518
------------------------------------------------------------------------------
    diff = mean(Lifting) - mean(Bending)                          t =   1.3301
H0: diff = 0                                     Degrees of freedom =      150

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9072         Pr(|T| > |t|) = 0.1855          Pr(T > t) = 0.0928

.
. tab group longest if survey==0, chi2

Interventi |
   on-Sham |        Longest Episode of Back Pain
     Group |      None  Less than  6-12 Week  Greater t |     Total
-----------+--------------------------------------------+----------
   Lifting |        49         18          6          3 |        76
   Bending |        51         22          2          5 |        80
-----------+--------------------------------------------+----------
     Total |       100         40          8          8 |       156

          Pearson chi2(3) =   2.8393   Pr = 0.417

.
```

```
. tab group med if survey==0, chi2

Interventi |   Took Medicine for
   on-Sham |       Back Pain
     Group |         No        Yes |     Total
-----------+----------------------+----------
   Lifting |         52         23 |        75
   Bending |         53         27 |        80
-----------+----------------------+----------
     Total |        105         50 |       155

          Pearson chi2(1) =   0.1684   Pr = 0.682

.
. tab group medcare if survey==0, chi2

Interventi |  Sought Medical Care
   on-Sham |     for Back Pain
     Group |         No        Yes |     Total
-----------+----------------------+----------
   Lifting |         67          8 |        75
   Bending |         70         10 |        80
-----------+----------------------+----------
     Total |        137         18 |       155

          Pearson chi2(1) =   0.1268   Pr = 0.722

.
. tab group imp if survey==0, chi2

Interventi |   Impairment due to
   on-Sham |      Back Pain
     Group |         No        Yes |     Total
-----------+----------------------+----------
   Lifting |         54         20 |        74
   Bending |         60         20 |        80
-----------+----------------------+----------
     Total |        114         40 |       154

          Pearson chi2(1) =   0.0821   Pr = 0.774

.
. tab group daw if survey==0, chi2

Interventi | Lost Day or more from
   on-Sham | work due to Back Pain
     Group |         No        Yes |     Total
-----------+----------------------+----------
   Lifting |         63         12 |        75
   Bending |         74          6 |        80
-----------+----------------------+----------
     Total |        137         18 |       155
```

```
          Pearson chi2(1) =   2.7248   Pr = 0.099

.



. tab group claim if survey==0, chi2

Interventi | Workers' Compensation
   on-Sham |         Claim
     Group |        No        Yes |     Total
-----------+----------------------+----------
   Lifting |        72          3 |        75
   Bending |        76          4 |        80
-----------+----------------------+----------
     Total |       148          7 |       155

          Pearson chi2(1) =   0.0898   Pr = 0.764

.
end of do-file

. log close
      name:  <unnamed>
       log:  C:\Users\georg\Desktop\Newest Analysis and Papers 210929\Log, tests to
determine differences at baseline 211114a.smcl
  log type:  smcl
 closed on:  14 Nov 2021, 18:06:08
```

18 APPENDIX V – ANALYSIS OF INTERVENTION IMPACT ON BEHAVIORS

(On Next Page)

There were three categories of behaviors that were evaluated over the course of the experiment:

1. Time between waking and either leaving for or arriving at work.
2. Activity during the first two hours after waking.
3. Exercise either at home within the two hours after waking and/or participation in UCLA"s "Warm-up for Work" start of shift exercise (whether within two hours after waking or sometime after that).

Combinations of activity and exercise were also evaluated. The following table summarizes the impact of the sham and treatment training on the behavioral variables:

Table 18-1. Regression coefficients and odds ratios for behavior outcomes by sham and treatment training.

		Sham				Treatment			
Behavior Outcome	Metric	Coefficient /Odds Ratio	p-value	Lower CI	Upper CI	Coefficient /Odds Ratio	p-value	Lower CI	Upper CI
Wake to Leave Time	Coeff.	-0.34	0.263	-0.93	0.25	0.09	0.554	-0.20	0.38
Wake to Work Time	Coeff.	-0.18	0.552	-0.79	0.42	0.08	0.581	-0.21	0.38
Activity (5 Levels)	OR	0.47	0.039	0.23	0.96	0.60	0.008	0.41	0.87
Activity (3 Levels)	OR	0.40	0.042	0.16	0.97	0.61	0.027	0.40	0.95
Exercise at Home within 2Hrs Rising	OR	1.29	0.608	0.49	3.35	0.69	0.142	0.42	1.14
UCLA - Warm-Up for Work	OR	0.28	0.119	0.06	1.39	0.31	0.002	0.15	0.64
UCLA -Warm-Up for Work w/in 2Hrs Rising	OR	1.98	0.648	0.11	37.31	0.84	0.744	0.30	2.35
Exercise Home w/in 2Hrs or UCLA	OR	0.56	0.262	0.20	1.55	0.45	0.003	0.27	0.76
Exercise Home or UCLA w/in 2Hrs	OR	1.35	0.528	0.53	3.41	0.71	0.163	0.44	1.15
Exercise-Activity (7 Levels)	OR	0.65	0.219	0.33	1.29	0.55	0.002	0.38	0.80

Table 18-2. Predicted time (hours) and probabilities of behaviors by survey and intervention group (sham or treatment).

Behavior Outcome	Metric	Baseline	Sham 1Yr	Sham 2Yr	Treatment 1Yr	Treatment 2Yr
Wake to Leave Time	Hours	4.35	4.08	4.10	4.50	4.52
Wake to Work Time	Hours	5.46	5.19	5.36	5.46	5.62
Activity						
Activity-None	Prob.	0.28	0.40	0.50	0.35	0.46
Activity-Minimal	Prob.	0.29	0.29	0.28	0.29	0.29
Activity-Moderate	Prob.	0.25	0.20	0.15	0.22	0.17
Activity-Considerable	Prob.	0.12	0.07	0.05	0.09	0.06
Activity-Nearly all the time	Prob.	0.07	0.04	0.02	0.04	0.03
Activity (3 Levels)						
Activity-None/Minimal	Prob.	0.54	0.75	0.78	0.68	0.72
Activity-Moderate	Prob.	0.26	0.17	0.15	0.21	0.19
Activity-Considerable/Nearly all the time	Prob.	0.20	0.08	0.07	0.11	0.09
Exercise at Home within 2Hrs Rising	Prob.	0.51	0.42	0.49	0.32	0.39
UCLA - Warm-Up for Work	Prob.	0.52	0.24	0.25	0.25	0.26
UCLA -Warm-Up for Work within 2Hrs Rising	Prob.	0.10	0.02	0.13	0.01	0.09
Exercise Home w/in 2Hrs or UCLA	Prob.	0.72	0.49	0.51	0.46	0.48
Exercise Home or UCLA w/in 2Hrs	Prob.	0.53	0.42	0.53	0.32	0.41
Exercise-Activity (7 Levels)						
No Activity/No Exercise	Prob.	0.16	0.27	0.31	0.30	0.34
Min Activity/Min Exercise	Prob.	0.25	0.29	0.30	0.30	0.30
Min Activity/Exercise	Prob.	0.13	0.12	0.12	0.12	0.11
Mod Activity/No Exercise	Prob.	0.11	0.09	0.08	0.09	0.08
Mod Activity/Exercise	Prob.	0.16	0.12	0.10	0.11	0.09
High Activity/No Exercise	Prob.	0.07	0.05	0.04	0.04	0.03
High Activity/Exercise	Prob.	0.11	0.06	0.05	0.05	0.04

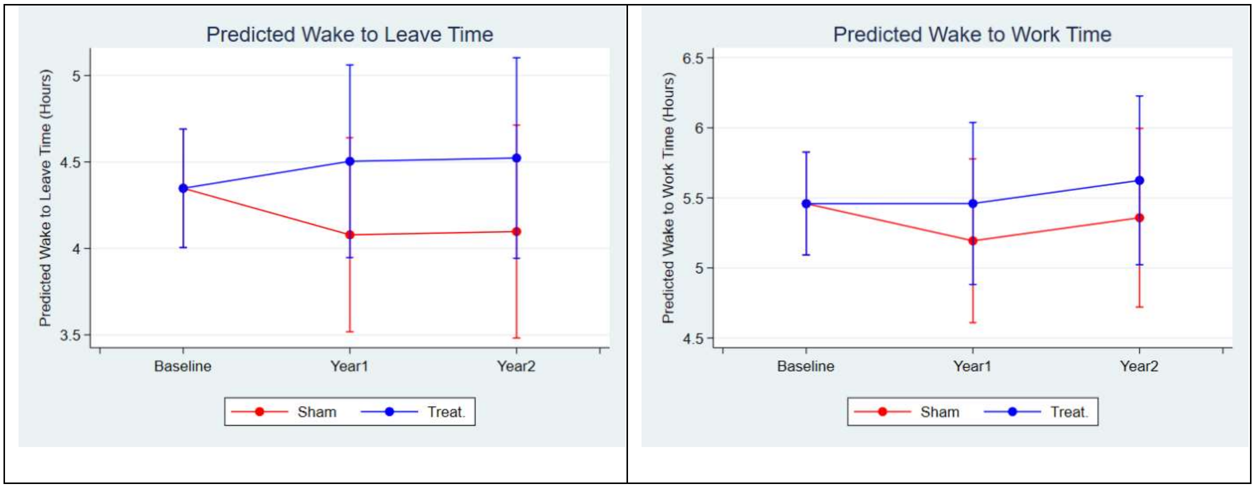
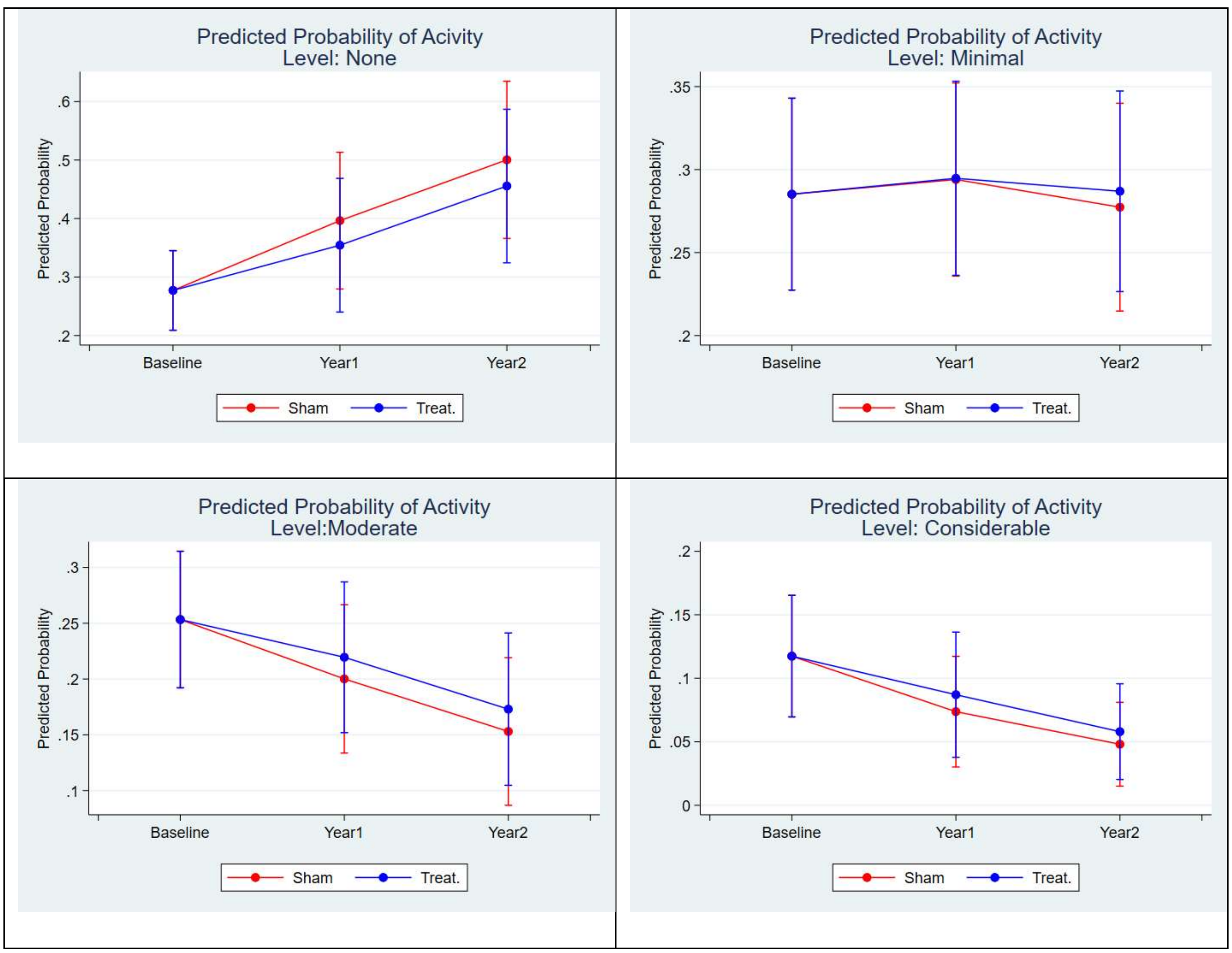


Figure 18-1. Predicted wake to leave for work and predicted wake to work times by survey and intervention group (sham or treatment).



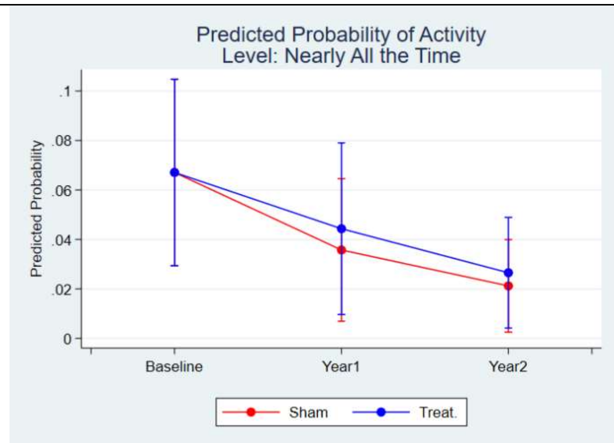


Figure 18-2. Predicted probabilities of 5 levels of activity within the first 2 hours after waking by survey and intervention group (sham or treatment).

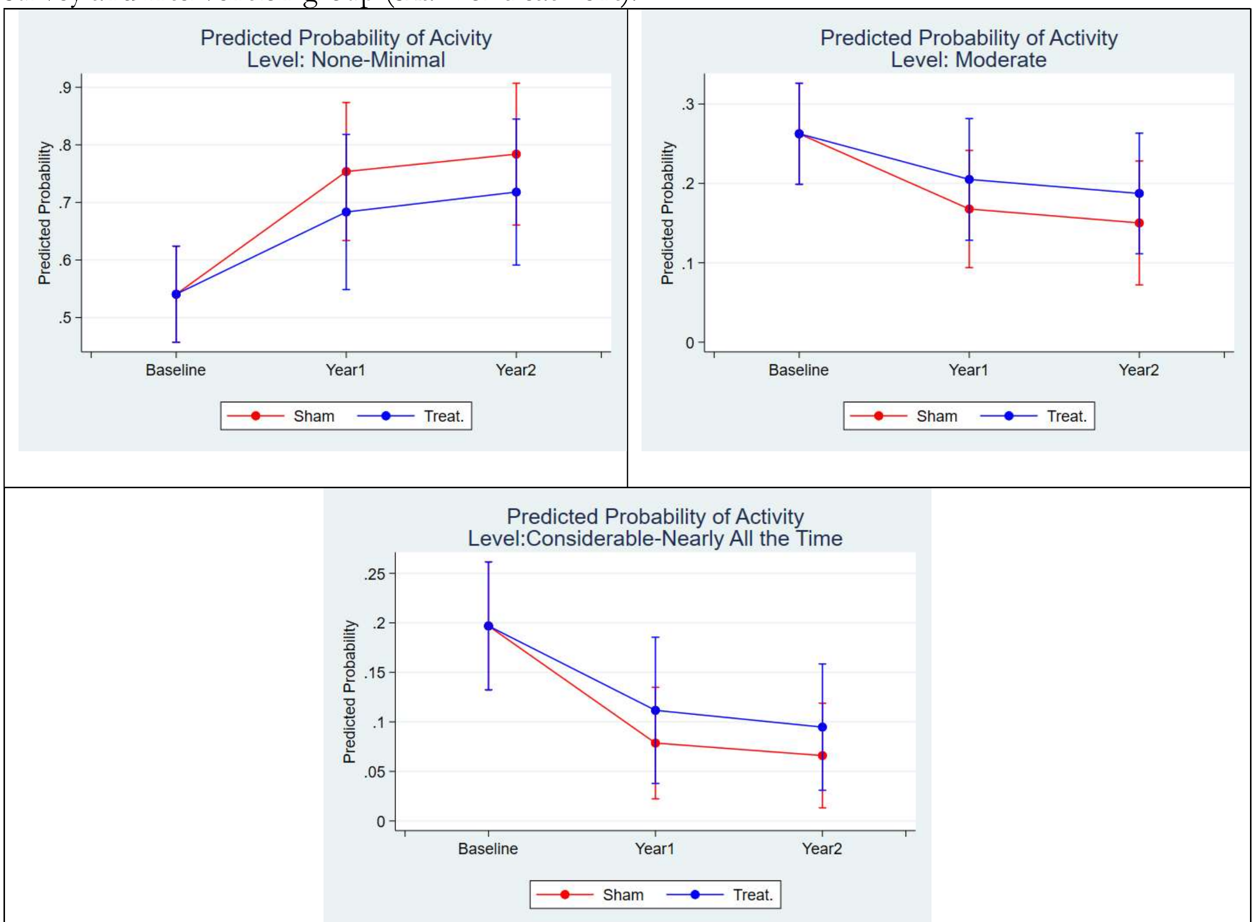


Figure 18-3. Predicted probability of 3 levels of activity by survey and intervention group (sham or treatment).

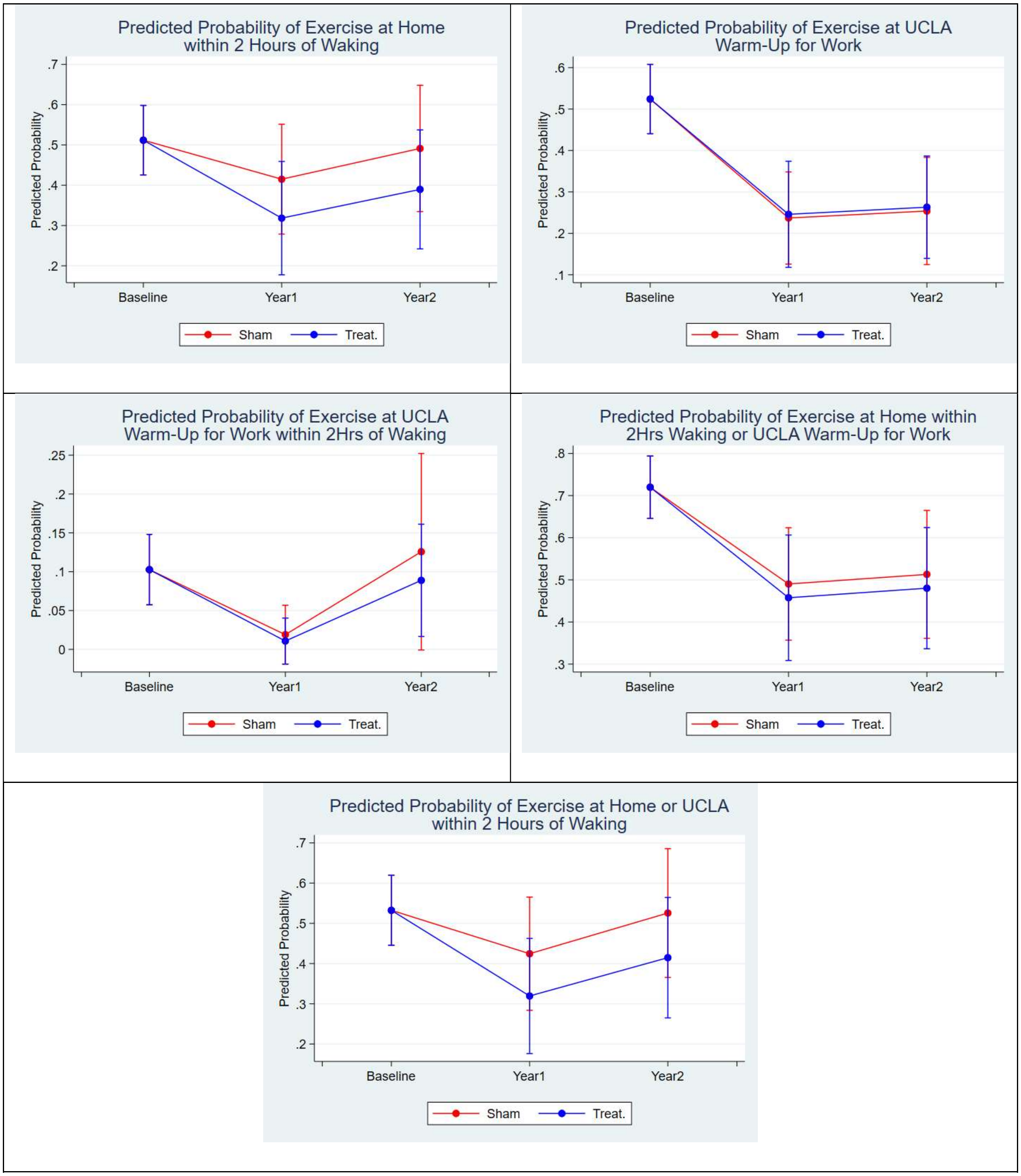
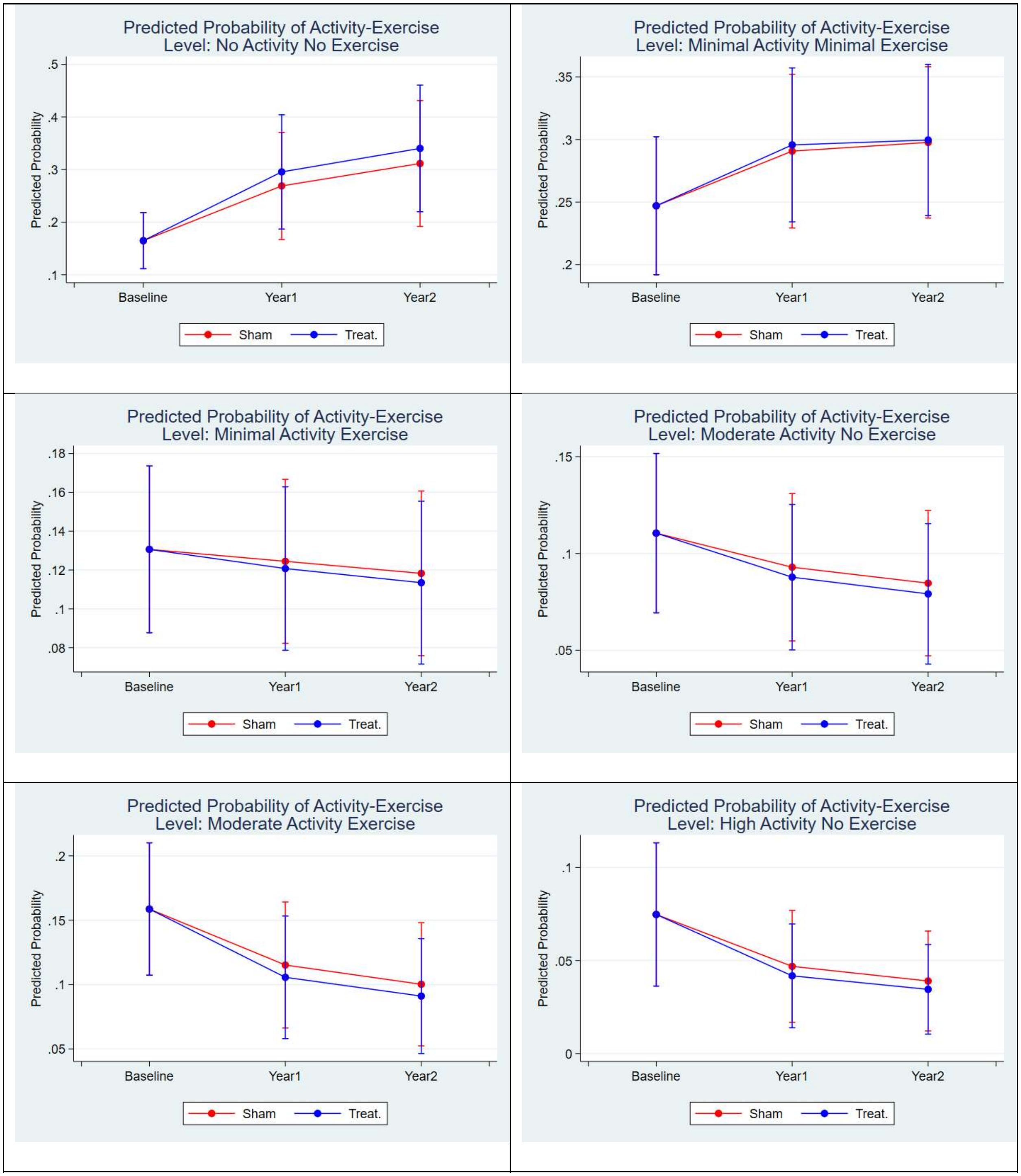


Figure 18-4. Predicted probabilities of exercises at home within two hours of waking or at UCLA , "Warm-up for Work", and combinations thereof.


Predicted Probability of Activity-Exercise
Level: No Activity No Exercise
Predicted Probability
.5
.4
.3
.2
.1
Baseline
Year1
Year2
Sham
Treat.
Predicted Probability of Activity-Exercise
Level: Minimal Activity Minimal Exercise
Predicted Probability
.35
.3
.25
.2
Baseline
Year1
Year2
Sham
Treat.
Predicted Probability of Activity-Exercise
Level: Minimal Activity Exercise
Predicted Probability
.18
.16
.14
.12
.1
.08
Baseline
Year1
Year2
Sham
Treat.
Predicted Probability of Activity-Exercise
Level: Moderate Activity No Exercise
Predicted Probability
.15
.1
.05
Baseline
Year1
Year2
Sham
Treat.
Predicted Probability of Activity-Exercise
Level: Moderate Activity Exercise
Predicted Probability
.2
.15
.1
.05
Baseline
Year1
Year2
Sham
Treat.
Predicted Probability of Activity-Exercise
Level: High Activity No Exercise
Predicted Probability
.1
.05
0
Baseline
Year1
Year2
Sham
Treat.

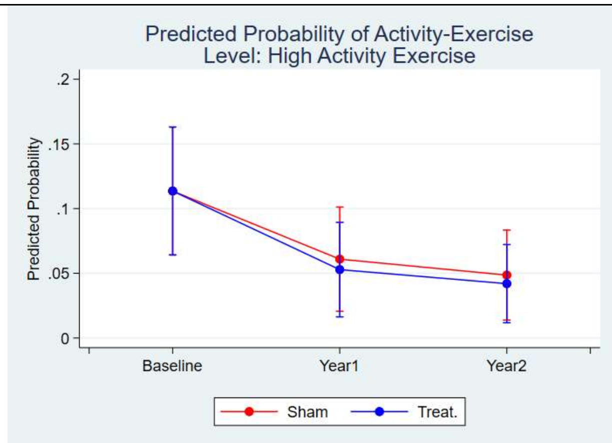


Figure 18-5. Predicted probability of 7 combinations of activity level and exercise (at home or UCLA within 2 hours of rising) by survey and intervention group (sham or treatment).

Table 18-3. Mixed Effects Linear Regression for Wake to Leave Time

	Mixed Effects Linear Regression				
	Coeff.	Std. error	z	p-value	95% CI
Time (hrs) between Rising & Leaving for Work					
Sex=Female	0.031	0.328	0.09	0.925	[-0.612,0.674]
Age (Centered)	-0.013	0.017	-0.76	0.447	[-0.047,0.021]
Number of lifts over 25 pounds/day	-0.023	0.013	-1.71	0.086	[-0.048,0.003]
Tenure	0.005	0.023	0.20	0.839	[-0.041,0.050]
Shift=Night	4.920	0.352	13.97	0.000	[4.230,5.610]
Sleep Time (hrs) on Average per 24hrs	-0.211	0.084	-2.51	0.012	[-0.376,-0.047]
Language (English or Spanish)=Spanish	0.485	0.299	1.62	0.104	[-0.101,1.071]
Have More than UCLA Job=Yes	-0.248	0.452	-0.55	0.583	[-1.134,0.638]
Stress level during past week=Some	-0.073	0.274	-0.26	0.791	[-0.610,0.465]
Stress level during past week=Most	-0.412	0.446	-0.92	0.356	[-1.287,0.462]
Sham Training (Lifting)=Impact 1yr After 1st Session	-0.338	0.302	-1.12	0.263	[-0.929,0.254]
Treatment Training (Bending)	0.087	0.148	0.59	0.554	[-0.203,0.378]
Survey=Year1	0.069	0.240	0.29	0.774	[-0.401,0.538]
Survey=Year2	0.000	0.000			
Intercept	2.133	0.688	3.10	0.002	[0.784,3.482]
lns1_1_1					
Intercept	0.338	0.109			[0.180,0.635]
lnsig_e					
Intercept	0.199	0.079			[0.091,0.434]

Table 18-4. Mixed Effects Linear Regression for Wake to Leave Time.

	Predict.Coeff.	Std. error	z	p-value	95% CI	
Sham@Baseline	4.347678	.1745723	24.90	0.000	4.005523	4.689833
Sham@Year1	4.078665	.2862621	14.25	0.000	3.517602	4.639728
Sham@Year2	4.097458	.3141103	13.04	0.000	3.481813	4.713103
Treat.@Baseline	4.347678	.1745723	24.90	0.000	4.005523	4.689833
Treat.@Year1	4.503876	.2842719	15.84	0.000	3.946713	5.061039
Treat.@Year2	4.522669	.2959253	15.28	0.000	3.942666	5.102672

1. The sham (lifting) training resulted in shorter wake to leave times, while the treatment training resulted in longer wake to leave times. Over the course of the experiment sham training decreased the wake to leave time by 0.338 hours (Coefficient, p, & [CI's]: -0.338, 0.263, [-0.929, 0.254]) while treatment training increased the wake to leave time by 0.087 hours (Coefficient, p, & [CI's}: 0.087, 0.554, [-0.203, 0.378]).
2. The predicted wake to leave time was 4.35 at baseline (for both sham and treatment subjects).
3. Sham subjects' wake to leave time one year after the sham training was 4.08 (6% lower than baseline).

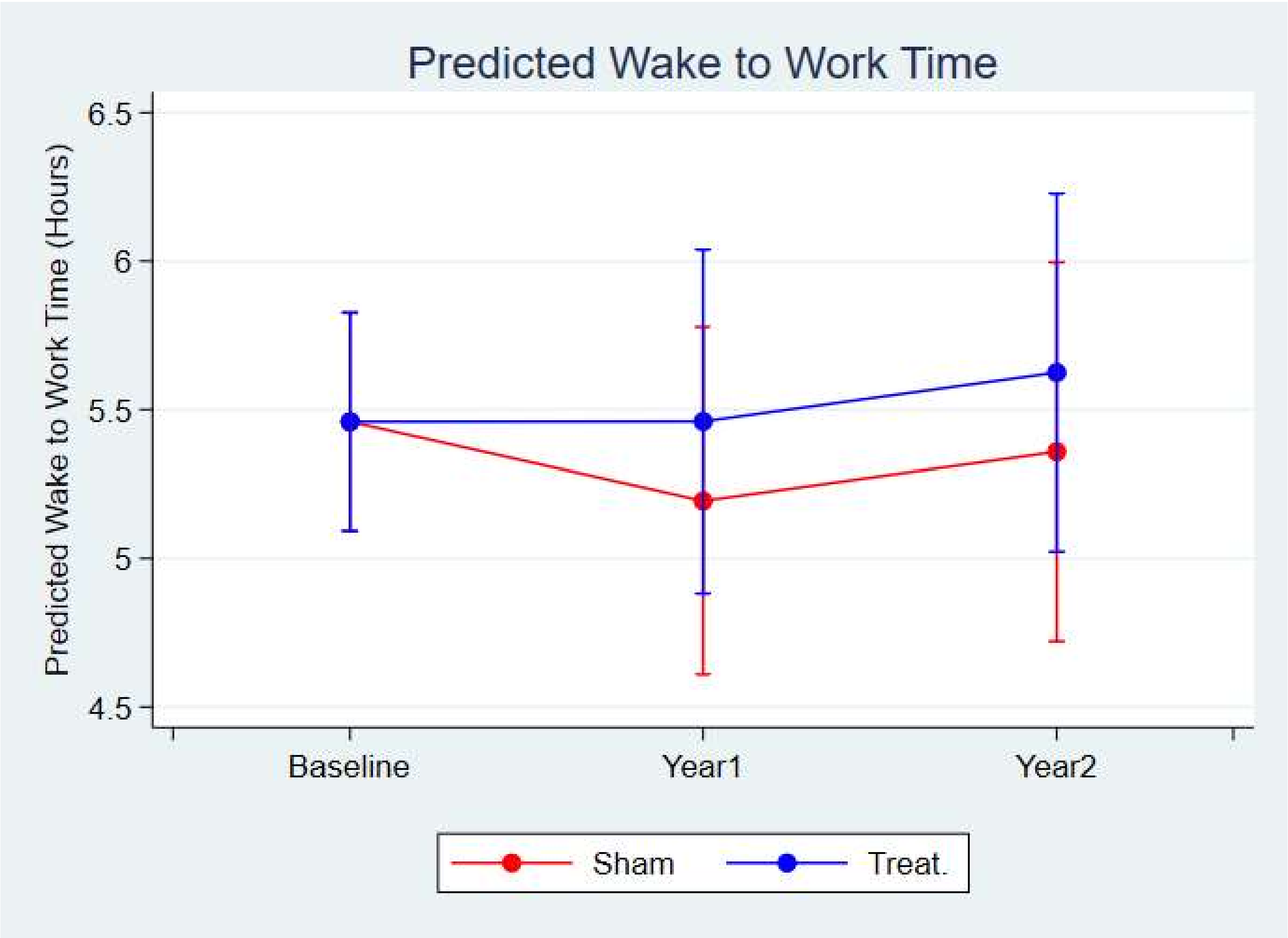
4. Sham subjects' wake to leave time two years after the sham training and one year after the treatment training was 4.1 (6% lower than baseline and 0% higher than one year after the sham training).
5. treatment subjects' wake to leave time one year after the treatment training was 4.50 (4% higher than baseline).
6. treatment subjects' wake to leave time two years after the first treatment training and one year after the second treatment training was 4.1 (6% lower than baseline and 0% higher than one year after the second treatment training).

Table 18-5. Mixed Effects Linear Regression for Wake to Work Time

	Mixed Effects Linear Regression				
	Coeff.	Std. error	z	p-value	95% CI
Time (hrs) between Rising & Arriving at Work					
Sex=Female	0.364	0.356	1.02	0.306	[-0.334,1.063]
Age (Centered)	-0.021	0.019	-1.11	0.265	[-0.058,0.016]
Number of lifts over 25 pounds/day	-0.015	0.013	-1.08	0.278	[-0.041,0.012]
Tenure	0.028	0.025	1.11	0.266	[-0.021,0.077]
Shift=Night	5.179	0.379	13.65	0.000	[4.435,5.922]
Sleep Time (hrs) on Average per 24hrs	-0.181	0.088	-2.05	0.041	[-0.354,-0.008]
Language (English or Spanish)=Spanish	0.277	0.311	0.89	0.374	[-0.333,0.887]
Have More than UCLA Job=Yes	-0.911	0.478	-1.90	0.057	[-1.849,0.027]
Stress level during past week=Some	-0.290	0.284	-1.02	0.307	[-0.847,0.267]
Stress level during past week=Most	-0.795	0.461	-1.72	0.085	[-1.698,0.108]
Sham Training (Lifting)=Impact 1yr After 1st Session	-0.184	0.309	-0.60	0.552	[-0.788,0.421]
Treatment Training (Bending)	0.083	0.150	0.55	0.581	[-0.211,0.377]
Survey=Year1	-0.082	0.241	-0.34	0.734	[-0.554,0.391]
Survey=Year2	0.000	0.000			
Intercept	2.900	0.728	3.99	0.000	[1.474,4.326]
lns1_1_1					
Intercept	0.465	0.098			[0.308,0.702]
lnsig_e					
Intercept	0.194	0.079			[0.087,0.430]

Table 18-6. Marginal Predicted Coefficients of Wake to work Time

	Predict.Coeff.	Std. error	z	p-value	95% CI	
Sham@Baseline	5.459166	.1873288	29.14	0.000	5.092008	5.826323
Sham@Year1	5.193647	.2981751	17.42	0.000	4.609235	5.77806
Sham@Year2	5.358309	.3252787	16.47	0.000	4.720774	5.995843
Treat.@Baseline	5.459166	.1873288	29.14	0.000	5.092008	5.826323
Treat.@Year1	5.460052	.2950347	18.51	0.000	4.881794	6.038309
Treat.@Year2	5.624713	.3072868	18.30	0.000	5.022442	6.226984



1. The sham (lifting) training resulted in shorter wake to work times, while the treatment training resulted in longer wake to work times. Over the course of the experiment sham training decreased the wake to work time by 0.184 hours (Coefficient, p, & [CI's]: -0.184, 0.552, [-0.788, 0.421]) while treatment training increased the wake to work time by 0.083 hours (Coefficient, p, & [CI's}: 0.083, 0.581, [-0.211, 0.377]).
2. The predicted wake to work time was 5.46 at baseline (for both sham and treatment subjects).
3. Sham subjects' wake to work time one year after the sham training was 5.19 (5% lower than baseline).

4. Sham subjects' wake to work time two years after the sham training and one year after the treatment training was 5.36 (2% lower than baseline and 3% higher than one year after the sham training).
5. treatment subjects' wake to work time one year after the treatment training was 5.46 (0% higher than baseline).
6. treatment subjects' wake to work time two years after the first treatment training and one year after the second treatment training was 5.36 (2% lower than baseline and 3% higher than one year after the second treatment training).

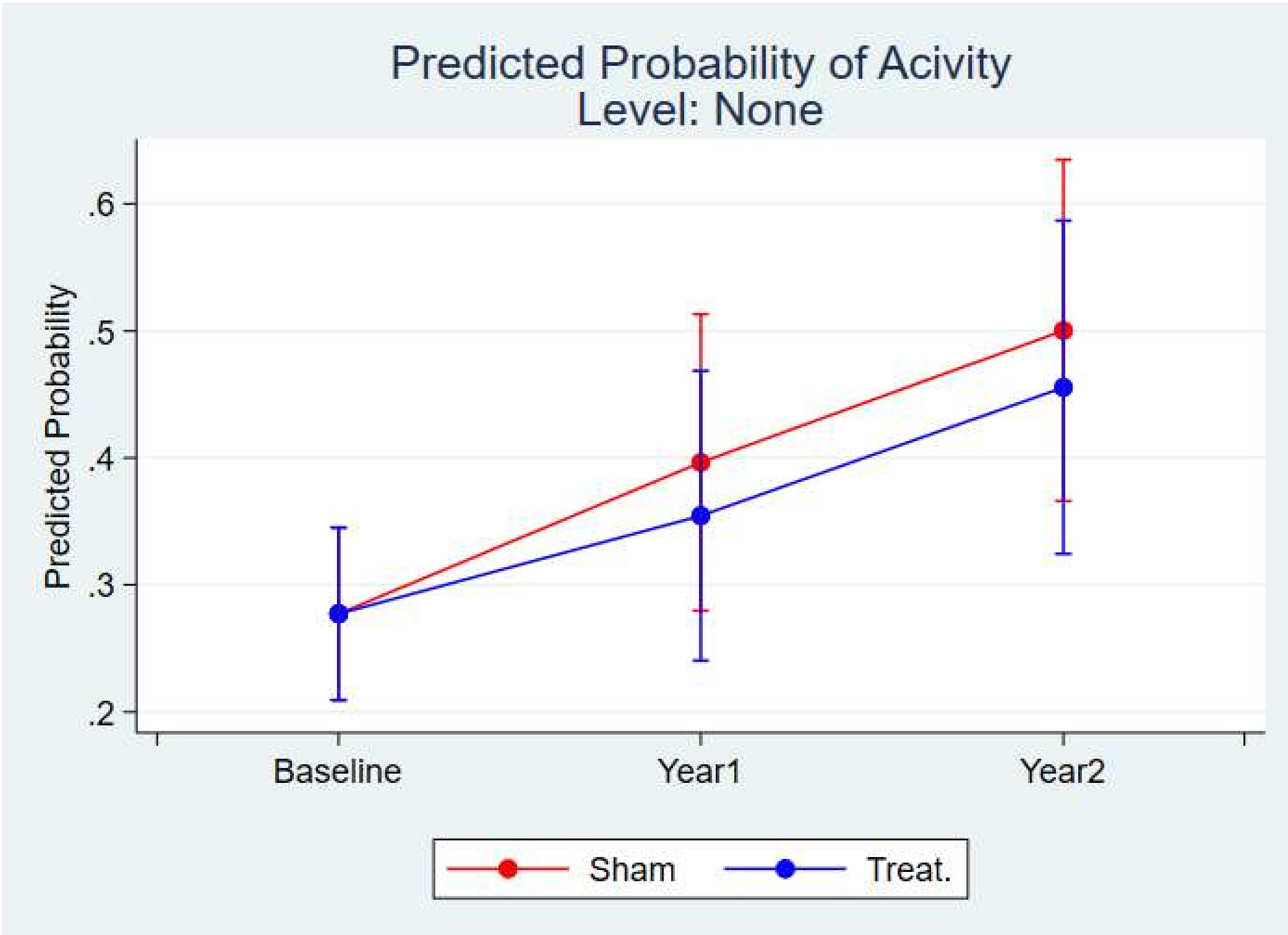
Table 18-7. Mixed Effects Ordered Logistic Regression for Activity within 2 Hours of Waking

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Activity Level within 2hrs rising					
Sex=Female	1.089	0.353	0.26	0.792	[0.577,2.056]
Age (Centered)	1.014	0.017	0.84	0.402	[0.981,1.048]
Number of lifts over 25 pounds/day	1.009	0.018	0.50	0.620	[0.975,1.044]
Tenure	0.994	0.022	-0.28	0.780	[0.952,1.038]
Shift=Night	0.738	0.260	-0.86	0.388	[0.370,1.471]
Sleep Time (hrs) on Average per 24hrs	0.836	0.076	-1.97	0.049	[0.699,0.999]
Language (English or Spanish)=Spanish	0.140	0.057	-4.86	0.000	[0.064,0.309]
Have More than UCLA Job=Yes	0.538	0.246	-1.35	0.176	[0.220,1.319]
Stress level during past week=Some	1.849	0.585	1.94	0.052	[0.994,3.439]
Stress level during past week=Most	2.567	1.257	1.93	0.054	[0.983,6.701]
Sham Training (Lifting)=Impact 1yr After 1st Session	0.468	0.172	-2.07	0.039	[0.228,0.961]
Treatment Training (Bending)	0.595	0.116	-2.66	0.008	[0.405,0.873]
Survey=Year1	1.044	0.325	0.14	0.889	[0.568,1.922]
Survey=Year2	1.000	0.000			
/					
cut1	-2.908	0.750			[-4.378,-1.437]
cut2	-1.300	0.721			[-2.712,0.113]
cut3	0.263	0.728			[-1.163,1.689]
cut4	1.580	0.777			[0.058,3.103]
var(_cons[idnum])	0.686	0.504			[0.162,2.895]

Table 18-8. Marginal Predicted Probability of Activity within 2 Hours of Waking

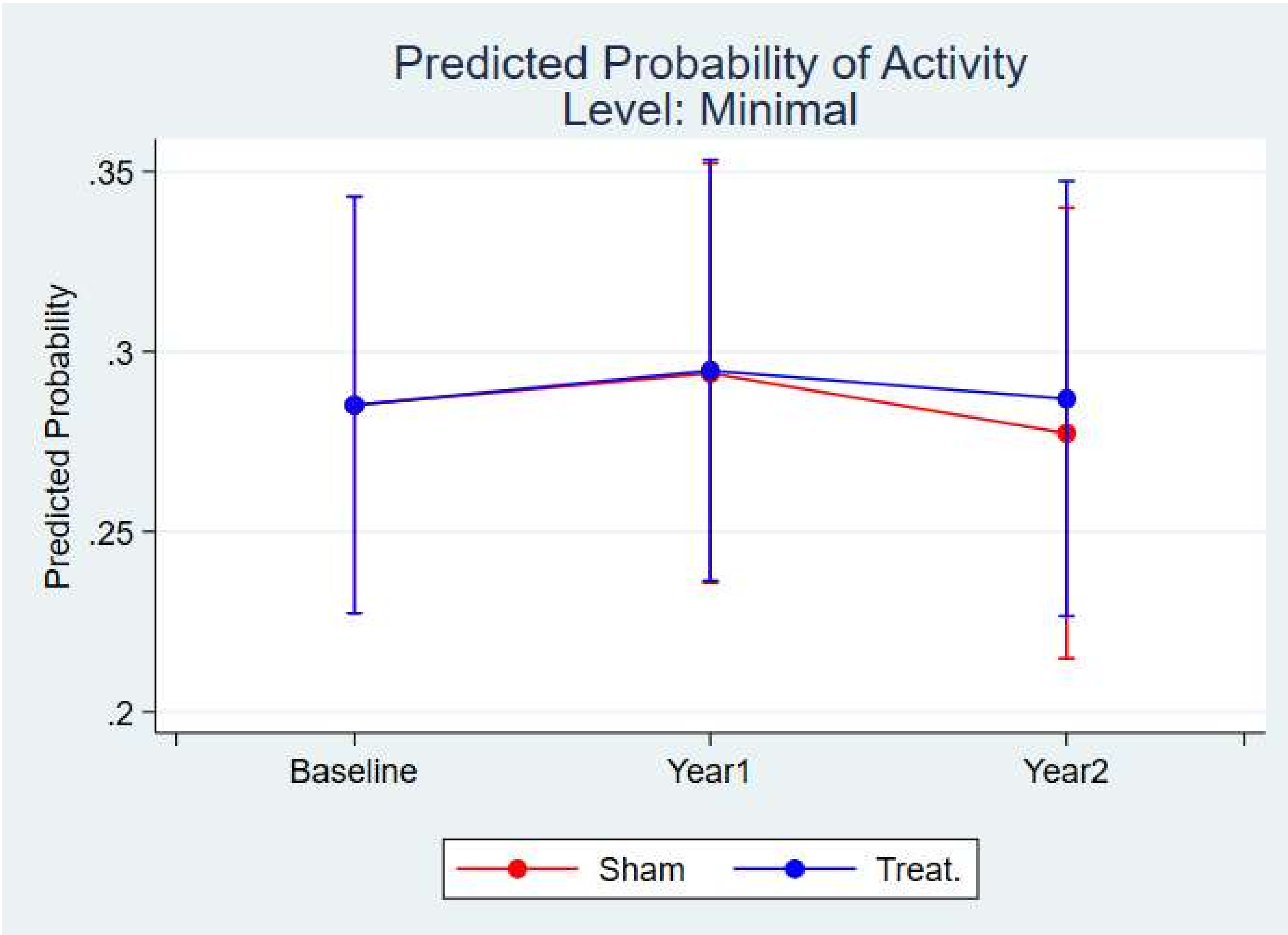
	Predict.Prob.	Std. error	z	p-value	95% CI	
None:Sham@Baseline	.2770599	.0347129	7.98	0.000	.2090238	.345096
None:Sham@Year1	.3964211	.0596359	6.65	0.000	.2795369	.5133053
None:Sham@Year2	.5003627	.0685499	7.30	0.000	.3660074	.634718
None:Treat.@Baseline	.2770599	.0347129	7.98	0.000	.2090238	.345096
None:Treat.@Year1	.3543644	.0582876	6.08	0.000	.2401228	.4686061
None:Treat.@Year2	.4555295	.0669348	6.81	0.000	.3243397	.5867193
Minimal:Sham@Baseline	.2851686	.0295082	9.66	0.000	.2273335	.3430036
Minimal:Sham@Year1	.2940108	.0296894	9.90	0.000	.2358207	.3522008
Minimal:Sham@Year2	.2773585	.0319362	8.68	0.000	.2147648	.3399522
Minimal:Treat.@Baseline	.2851686	.0295082	9.66	0.000	.2273335	.3430036
Minimal:Treat.@Year1	.2947489	.0298432	9.88	0.000	.2362574	.3532404
Minimal:Treat.@Year2	.2869281	.0308253	9.31	0.000	.2265117	.3473446
Moderate:Sham@Baseline	.2532932	.0312278	8.11	0.000	.1920878	.3144986
Moderate:Sham@Year1	.2001318	.0339097	5.90	0.000	.1336699	.2665936
Moderate:Sham@Year2	.1530114	.0337519	4.53	0.000	.0868589	.219164
Moderate:Treat.@Baseline	.2532932	.0312278	8.11	0.000	.1920878	.3144986
Moderate:Treat.@Year1	.2194978	.0344615	6.37	0.000	.1519544	.2870411
Moderate:Treat.@Year2	.1730146	.0348166	4.97	0.000	.1047754	.2412539
Considerable:Sham@Baseline	.1174097	.0244224	4.81	0.000	.0695427	.1652768
Considerable:Sham@Year1	.0737069	.0222152	3.32	0.001	.0301659	.117248
Considerable:Sham@Year2	.0480566	.0168322	2.86	0.004	.0150661	.0810471
Considerable:Treat.@Baseline	.1174097	.0244224	4.81	0.000	.0695427	.1652768
Considerable:Treat.@Year1	.0870615	.025137	3.46	0.001	.0377938	.1363291
Considerable:Treat.@Year2	.0579868	.0192201	3.02	0.003	.0203161	.0956576
Nearly All the Time:Sham@Baseline	.0670687	.0192272	3.49	0.000	.0293841	.1047532
Nearly All the Time:Sham@Year1	.0357294	.0147004	2.43	0.015	.0069171	.0645417
Nearly All the Time:Sham@Year2	.0212107	.0095403	2.22	0.026	.0025121	.0399094
Nearly All the Time:Treat.@Baseline	.0670687	.0192272	3.49	0.000	.0293841	.1047532
Nearly All the Time:Treat.@Year1	.0443275	.0177	2.50	0.012	.009636	.0790189
Nearly All the Time:Treat.@Year2	.0265409	.0114143	2.33	0.020	.0041692	.0489125

1. Both the sham (lifting) and treatment (bending) training decreased the odds of higher activity levels (5 levels) (odds ratio, p, & [CI's]: 0.468, 0.039, [0.228,0.961] and 0.595, 0.008, [0.405,0.873], sham and treatment training respectively). This represents 53% decreased odds of reporting higher activity levels (5 levels) for sham subjects receiving the sham (lifting) training and 41% decreased odds of reporting higher activity levels (5 levels) for the treatment training (bending) over the course of the study.



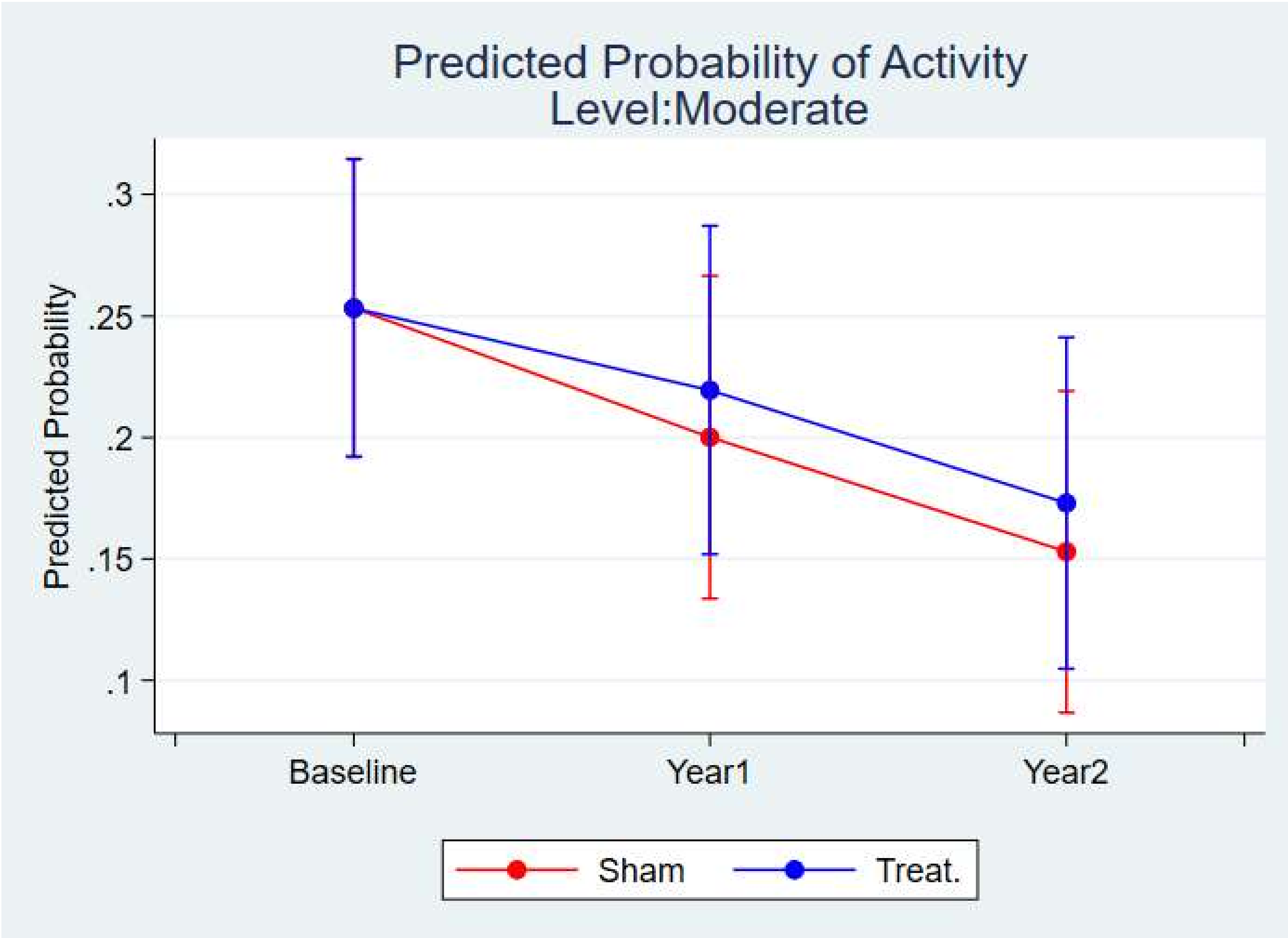
2. The predicted probability of reporting no activity within 2 hours of rising was 0.28 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting no activity within 2 hours of rising one year after the sham training was 0.40 (43% higher than baseline).
4. The predicted probability of sham subjects reporting no activity within 2 hours of rising two years after the sham training and one year

after the treatment training was 0.5 (81% higher than baseline and 26% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting no activity within 2 hours of rising one year after the treatment training was 0.35 (28% higher than baseline).
6. The predicted probability of treatment subjects reporting no activity within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.5 (81% higher than baseline and 26% higher than one year after the second treatment training).



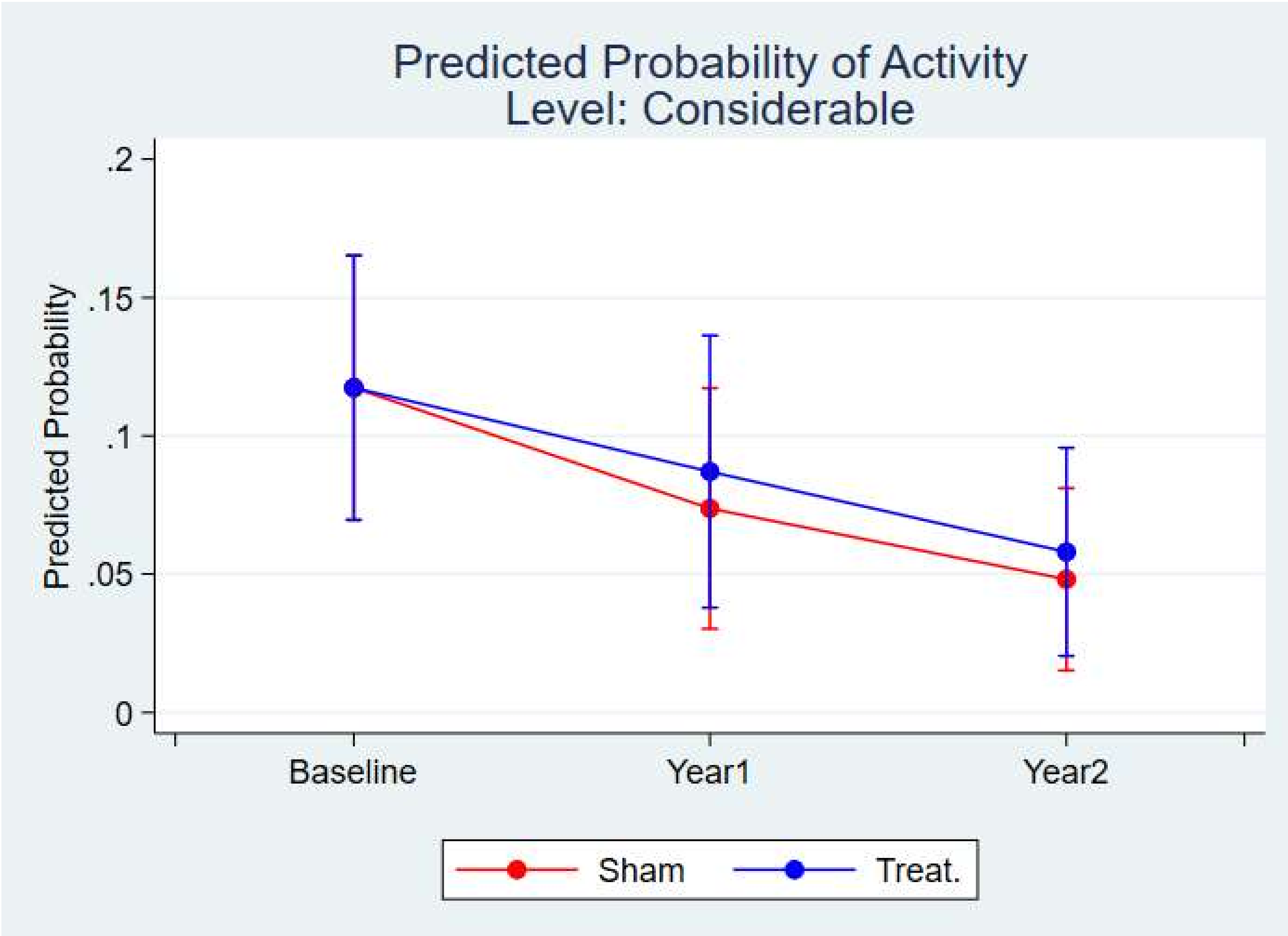
2. The predicted probability of reporting minimal activity withing 2 hours of rising was 0.29 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting minimal activity withing 2 hours of rising one year after the sham training was 0.29 (3% higher than baseline).

4. The predicted probability of sham subjects reporting minimal activity withing 2 hours of rising two years after the sham training and one year after the treatment training was 0.28 (3% lower than baseline and 6% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting minimal activity withing 2 hours of rising one year after the treatment training was 0.29 (3% higher than baseline).
6. The predicted probability of treatment subjects reporting minimal activity withing 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.28 (3% lower than baseline and 6% lower than one year after the second treatment training).



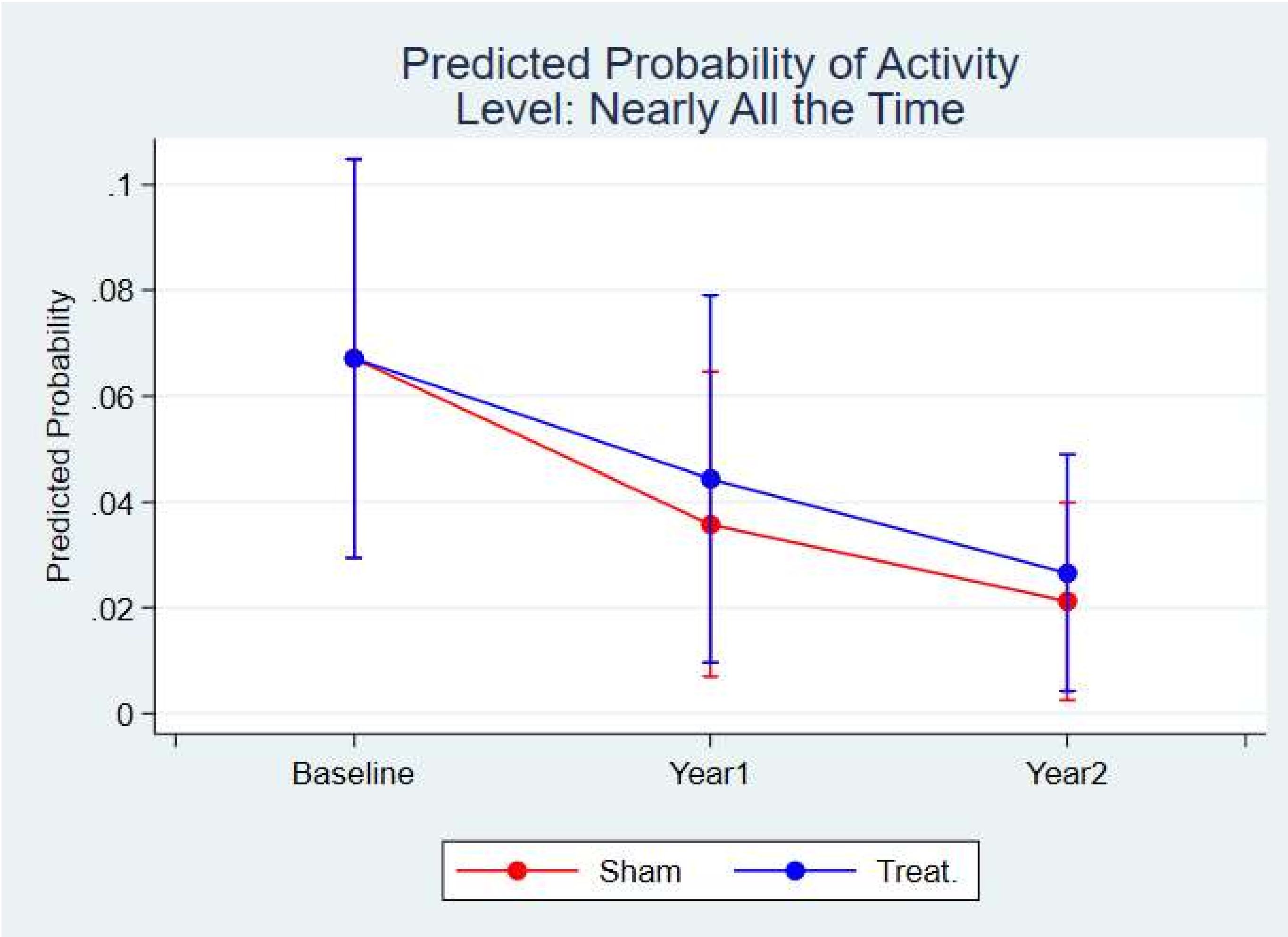
2. The predicted probability of reporting moderate activity within 2 hours of rising was 0.25 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting moderate activity within 2 hours of rising one year after the sham training was 0.20 (21% lower than baseline).

4. The predicted probability of sham subjects reporting moderate activity within 2 hours of rising two years after the sham training and one year after the treatment training was 0.15 (40% lower than baseline and 24% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting moderate activity within 2 hours of rising one year after the treatment training was 0.22 (13% lower than baseline).
6. The predicted probability of treatment subjects reporting moderate activity within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.15 (40% lower than baseline and 24% lower than one year after the second treatment training).



2. The predicted probability of reporting considerable activity within 2 hours of rising was 0.12 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting considerable activity within 2 hours of rising one year after the sham training was 0.07 (37% lower than baseline).

4. The predicted probability of sham subjects reporting considerable activity within 2 hours of rising two years after the sham training and one year after the treatment training was 0.05 (59% lower than baseline and 35% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting considerable activity within 2 hours of rising one year after the treatment training was 0.09 (26% lower than baseline).
6. The predicted probability of treatment subjects reporting considerable activity within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.05 (59% lower than baseline and 35% lower than one year after the second treatment training).



2. The predicted probability of reporting activity nearly all the time within 2 hours of rising was 0.07 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting activity nearly all the time within 2 hours of rising one year after the sham training was 0.04 (47% lower than baseline).

4. The predicted probability of sham subjects reporting activity nearly all the time within 2 hours of rising two years after the sham training and one year after the treatment training was 0.02 (68% lower than baseline and 41% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting activity nearly all the time within 2 hours of rising one year after the treatment training was 0.04 (34% lower than baseline).
6. The predicted probability of treatment subjects reporting activity nearly all the time within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.02 (68% lower than baseline and 41% lower than one year after the second treatment training).

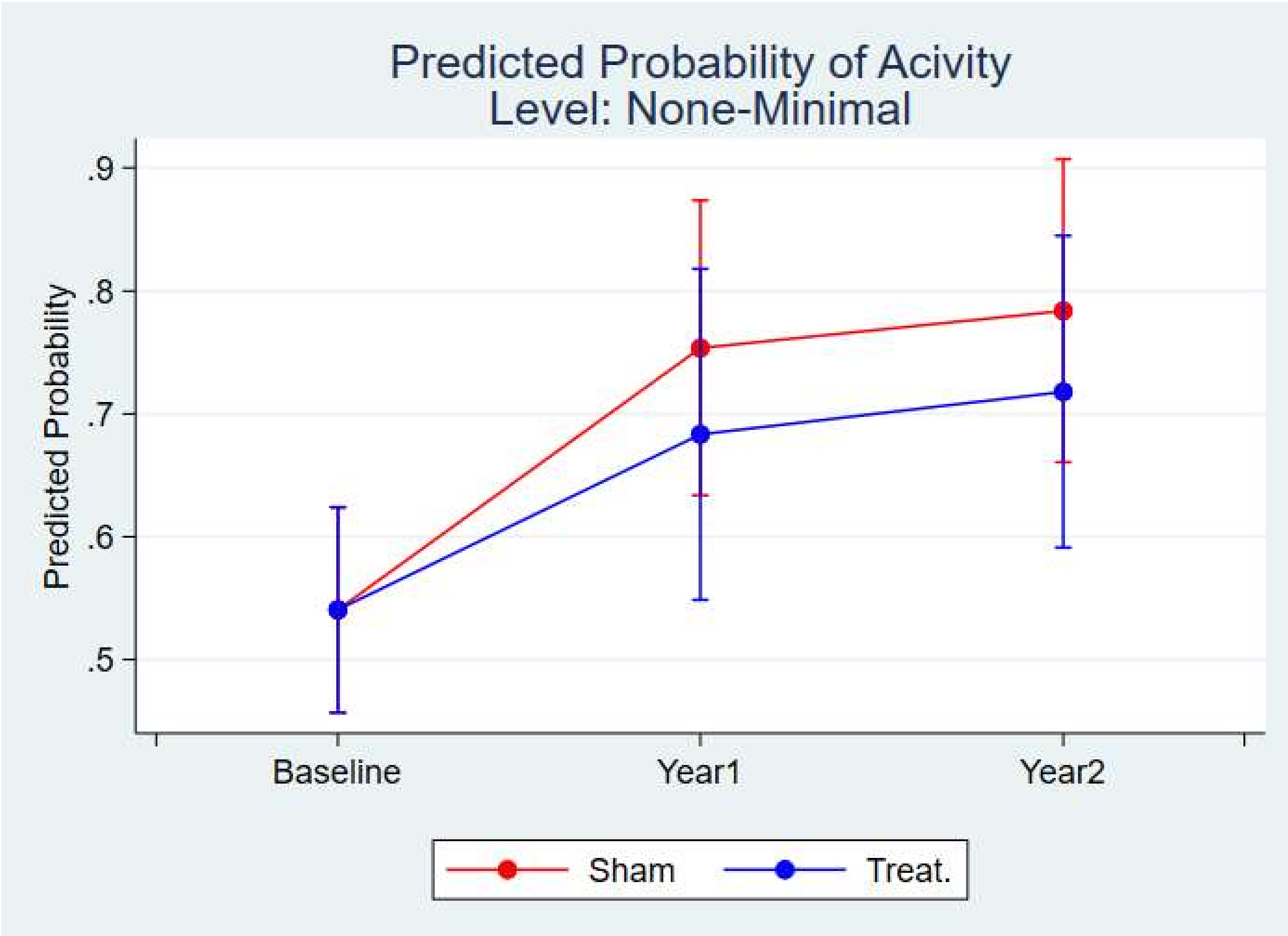
Table 18-9. Mixed Effects Ordered Logistic Regression for Activity within 2 Hours of Waking (3 Levels)

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Activity (Non/Minimal, Moderate, Considerable/Nearly-All-The-Time)					
Sex=Female	0.877	0.318	-0.36	0.718	[0.431,1.785]
Age (Centered)	1.011	0.019	0.59	0.554	[0.975,1.048]
Number of lifts over 25 pounds/day	1.016	0.019	0.88	0.377	[0.980,1.054]
Tenure	1.000	0.024	0.01	0.995	[0.954,1.049]
Shift=Night	0.609	0.239	-1.26	0.207	[0.282,1.316]
Sleep Time (hrs) on Average per 24hrs	0.867	0.094	-1.32	0.188	[0.702,1.072]
Language (English or Spanish)=Spanish	0.147	0.074	-3.81	0.000	[0.055,0.395]
Have More than UCLA Job=Yes	0.391	0.208	-1.76	0.078	[0.138,1.110]
Stress level during past week=Some	1.795	0.649	1.62	0.106	[0.883,3.647]
Stress level during past week=Most	1.939	1.025	1.25	0.210	[0.688,5.462]
Sham Training (Lifting)=Impact 1yr After 1st Session	0.396	0.181	-2.03	0.042	[0.162,0.968]
Treatment Training (Bending)	0.611	0.136	-2.21	0.027	[0.395,0.945]
Survey=Year1	0.751	0.292	-0.74	0.461	[0.351,1.608]
Survey=Year2	1.000	0.000			
/					
cut1	-1.422	0.856			[-3.100,0.255]
cut2	0.140	0.866			[-1.557,1.837]
var(_cons[idnum])	0.592	0.590			[0.084,4.178]

Table 18-10. Marginal Predicted Probability of Activity within 2 Hours of Waking (3 Levels)

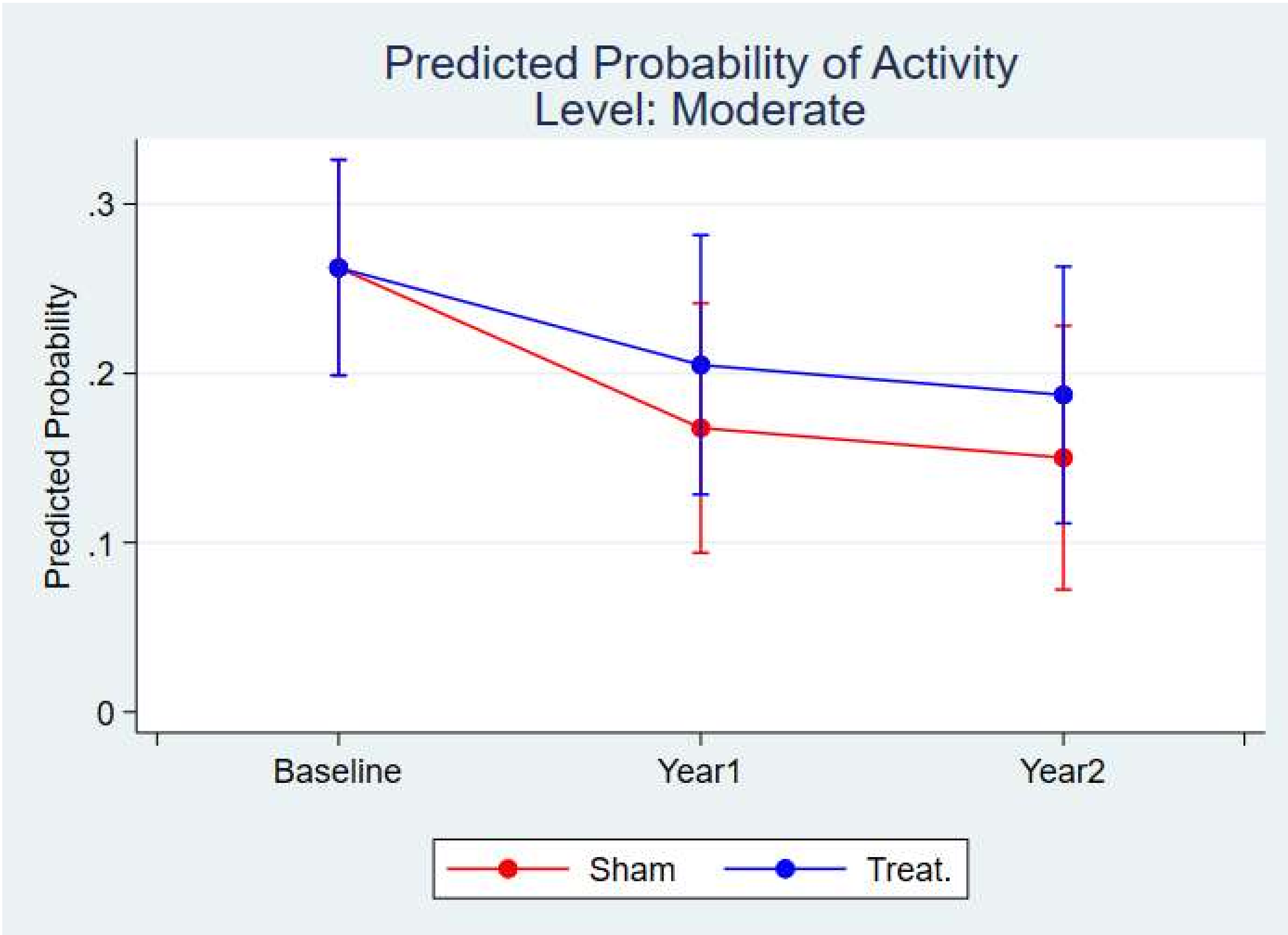
	Predict.Prob.	Std. error	z	p-value	95% CI	
None-Minimal:Sham@Baseline	.5405973	.0425301	12.71	0.000	.4572399	.6239547
None-Minimal:Sham@Year1	.7536317	.0611681	12.32	0.000	.6337444	.8735191
None-Minimal:Sham@Year2	.7838109	.0628451	12.47	0.000	.6606368	.906985
None-Minimal:Treat.@Baseline	.5405973	.0425301	12.71	0.000	.4572399	.6239547
None-Minimal:Treat.@Year1	.6832993	.0687306	9.94	0.000	.5485899	.8180088
None-Minimal:Treat.@Year2	.7179447	.0646998	11.10	0.000	.5911353	.844754
Moderate:Sham@Baseline	.2625571	.0324747	8.08	0.000	.1989079	.3262063
Moderate:Sham@Year1	.1677633	.037683	4.45	0.000	.093906	.2416207
Moderate:Sham@Year2	.1501968	.0398299	3.77	0.000	.0721316	.2282619
Moderate:Treat.@Baseline	.2625571	.0324747	8.08	0.000	.1989079	.3262063
Moderate:Treat.@Year1	.2050319	.0390806	5.25	0.000	.1284354	.2816284
Moderate:Treat.@Year2	.1873374	.0387609	4.83	0.000	.1113675	.2633074
Considerable-Nearly All the Time:Sham@Baseline	.1968456	.0329679	5.97	0.000	.1322297	.2614614
Considerable-Nearly All the Time:Sham@Year1	.0786049	.0287437	2.73	0.006	.0222682	.1349416
Considerable-Nearly All the Time:Sham@Year2	.0659923	.0269452	2.45	0.014	.0131807	.1188039
Considerable-Nearly All the Time:Treat.@Baseline	.1968456	.0329679	5.97	0.000	.1322297	.2614614
Considerable-Nearly All the Time:Treat.@Year1	.1116687	.0376516	2.97	0.003	.037873	.1854645
Considerable-Nearly All the Time:Treat.@Year2	.0947179	.0325329	2.91	0.004	.0309545	.1584813

1. Both the sham (lifting) and treatment (bending) training decreased the odds of higher activity levels (3 levels) (odds ratio, p, & [CI's]: 0.396, 0.042, [0.162,0.968] and 0.611, 0.027, [0.395,0.945], sham and treatment training respectively). This represents 60% decreased odds of reporting higher activity levels (3 levels) for sham subjects receiving the sham (lifting) training and 39% decreased odds of reporting higher activity levels (3 levels) for the treatment training (bending) over the course of the study.



2. The predicted probability of reporting none-minimal activity within 2 hours of rising was 0.54 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting none-minimal activity within 2 hours of rising one year after the sham training was 0.75 (39% higher than baseline).
4. The predicted probability of sham subjects reporting none-minimal activity within 2 hours of rising two years after the sham training and one year after the treatment training was 0.78 (45% higher than baseline and 4% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting none-minimal activity within 2 hours of rising one year after the treatment training was 0.68 (26% higher than baseline).
6. The predicted probability of treatment subjects reporting none-minimal activity within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.78 (45% higher than baseline and 4% higher than one year after the second treatment training).



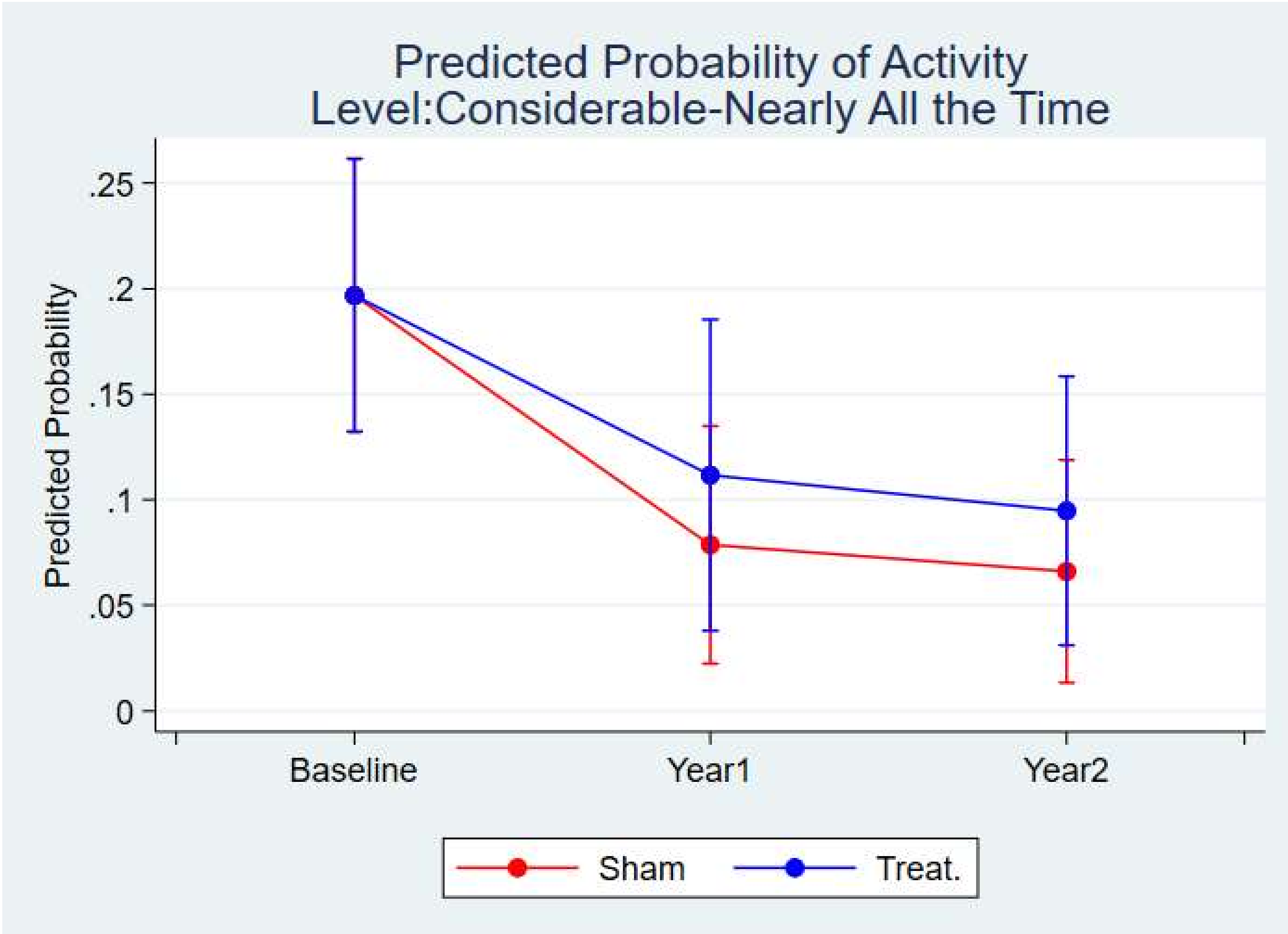
2. The predicted probability of reporting moderate activity within 2 hours of rising was 0.26 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting moderate activity within 2 hours of rising one year after the sham training was 0.17 (36%

lower than baseline).

4. The predicted probability of sham subjects reporting moderate activity within 2 hours of rising two years after the sham training and one year after the treatment training was 0.15 (43% lower than baseline and 10% lower than one year after the sham training).

5. The predicted probability of treatment subjects reporting moderate activity within 2 hours of rising one year after the treatment training was 0.21 (22% lower than baseline).

6. The predicted probability of treatment subjects reporting moderate activity within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.15 (43% lower than baseline and 10% lower than one year after the second treatment training).



2. The predicted probability of reporting considerable activity or activity nearly all the time within 2 hours of rising was 0.2 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting considerable activity or activity nearly all the time within 2 hours of rising one year

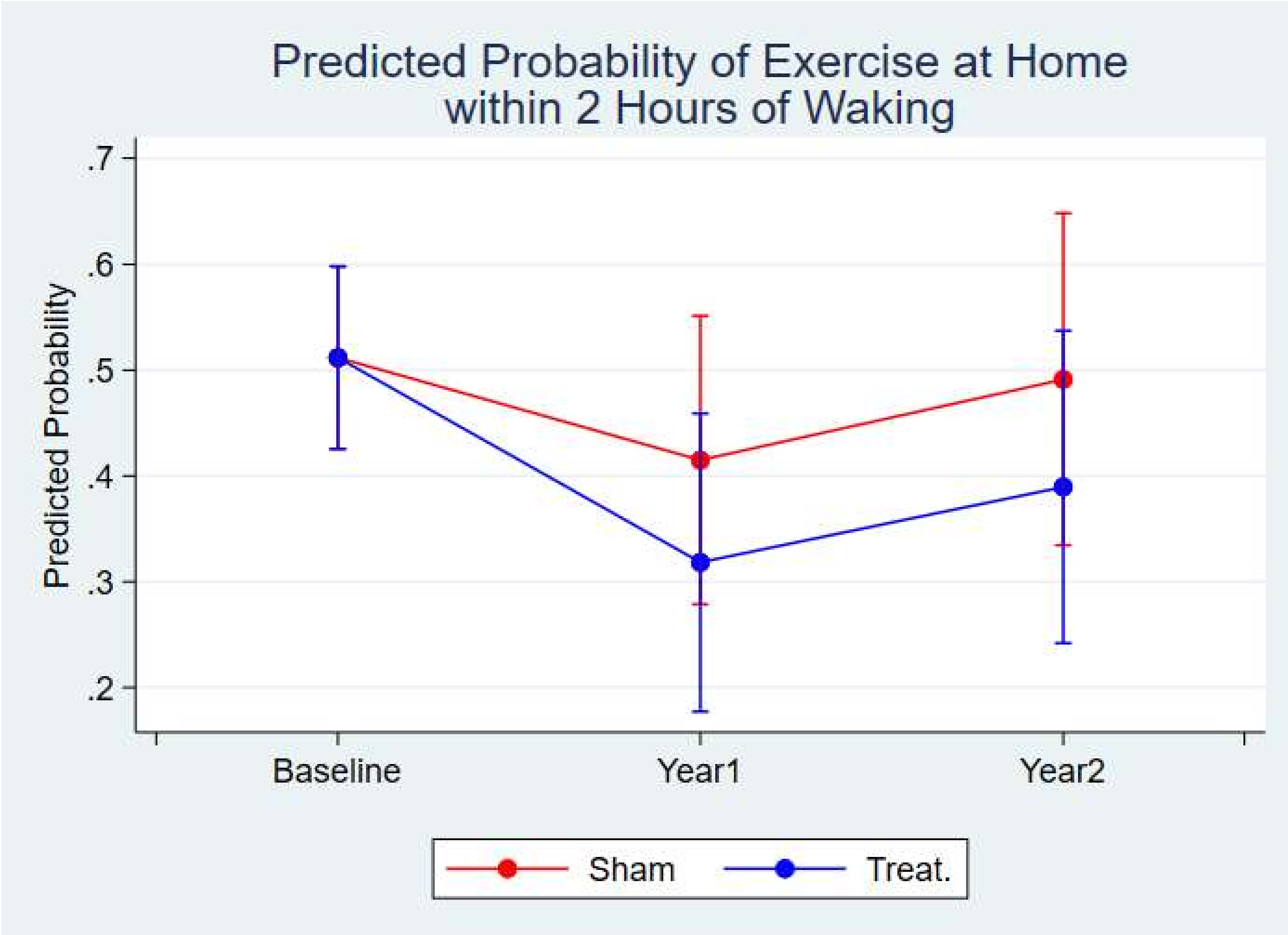
after the sham training was 0.08 (60% lower than baseline).
4. The predicted probability of sham subjects reporting considerable activity or activity nearly all the time within 2 hours of rising two years after the sham training and one year after the treatment training was 0.07 (66% lower than baseline and 16% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting considerable activity or activity nearly all the time within 2 hours of rising one year after the treatment training was 0.11 (43% lower than baseline).
6. The predicted probability of treatment subjects reporting considerable activity or activity nearly all the time within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.07 (66% lower than baseline and 16% lower than one year after the second treatment training).

Table 18-11. Mixed Effects Logistic Regression for Exercise at Home within 2 Hours of Waking

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Exercise at home within 2hrs rising					
Sex=Female	1.250	0.575	0.48	0.628	[0.507,3.080]
Age (Centered)	1.051	0.027	1.97	0.048	[1.000,1.105]
Number of lifts over 25 pounds/day	0.988	0.021	-0.56	0.574	[0.947,1.031]
Tenure	1.007	0.031	0.21	0.830	[0.947,1.070]
Shift=Night	1.199	0.618	0.35	0.725	[0.437,3.292]
Sleep Time (hrs) on Average per 24hrs	1.253	0.166	1.71	0.087	[0.967,1.624]
Language (English or Spanish)=Spanish	1.003	0.482	0.01	0.995	[0.391,2.573]
Have More than UCLA Job=Yes	4.356	2.997	2.14	0.032	[1.131,16.777]
Stress level during past week=Some	0.504	0.231	-1.50	0.134	[0.205,1.236]
Stress level during past week=Most	1.432	0.943	0.55	0.585	[0.394,5.204]
Sham Training (Lifting)=Impact 1yr After 1st Session	1.285	0.628	0.51	0.608	[0.493,3.350]
Treatment Training (Bending)	0.687	0.176	-1.47	0.142	[0.415,1.135]
Survey=Year1	0.430	0.188	-1.94	0.053	[0.183,1.011]
Survey=Year2	1.000	0.000			
Intercept	0.210	0.225	-1.45	0.146	[0.026,1.724]
/					
var(_cons[idnum])	2.295	1.368			[0.713,7.383]

Table 18-12. Marginal Predicted Probability of Exercise at Home within 2 Hours of Waking

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.5118574	.0440009	11.63	0.000	.4256171	.5980977
Sham@Year1	.4150112	.0695624	5.97	0.000	.2786715	.551351
Sham@Year2	.4912367	.0799513	6.14	0.000	.334535	.6479384
Treat.@Baseline	.5118574	.0440009	11.63	0.000	.4256171	.5980977
Treat.@Year1	.318388	.0717902	4.43	0.000	.1776818	.4590943
Treat.@Year2	.3896133	.075351	5.17	0.000	.2419281	.5372984



1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of exercising at home within 2 hours of rising (odds ratio, p, & [CI's]: 1.285, 0.608, [0.493,3.35] and 0.687, 0.142, [0.415,1.135], sham and treatment training respectively). This represents 29% increased odds of reporting exercising at home within 2 hours of rising for sham subjects receiving the sham (lifting) training and 31% decreased odds of reporting exercising at home within 2 hours of rising for the treatment training (bending) over the course of the study.

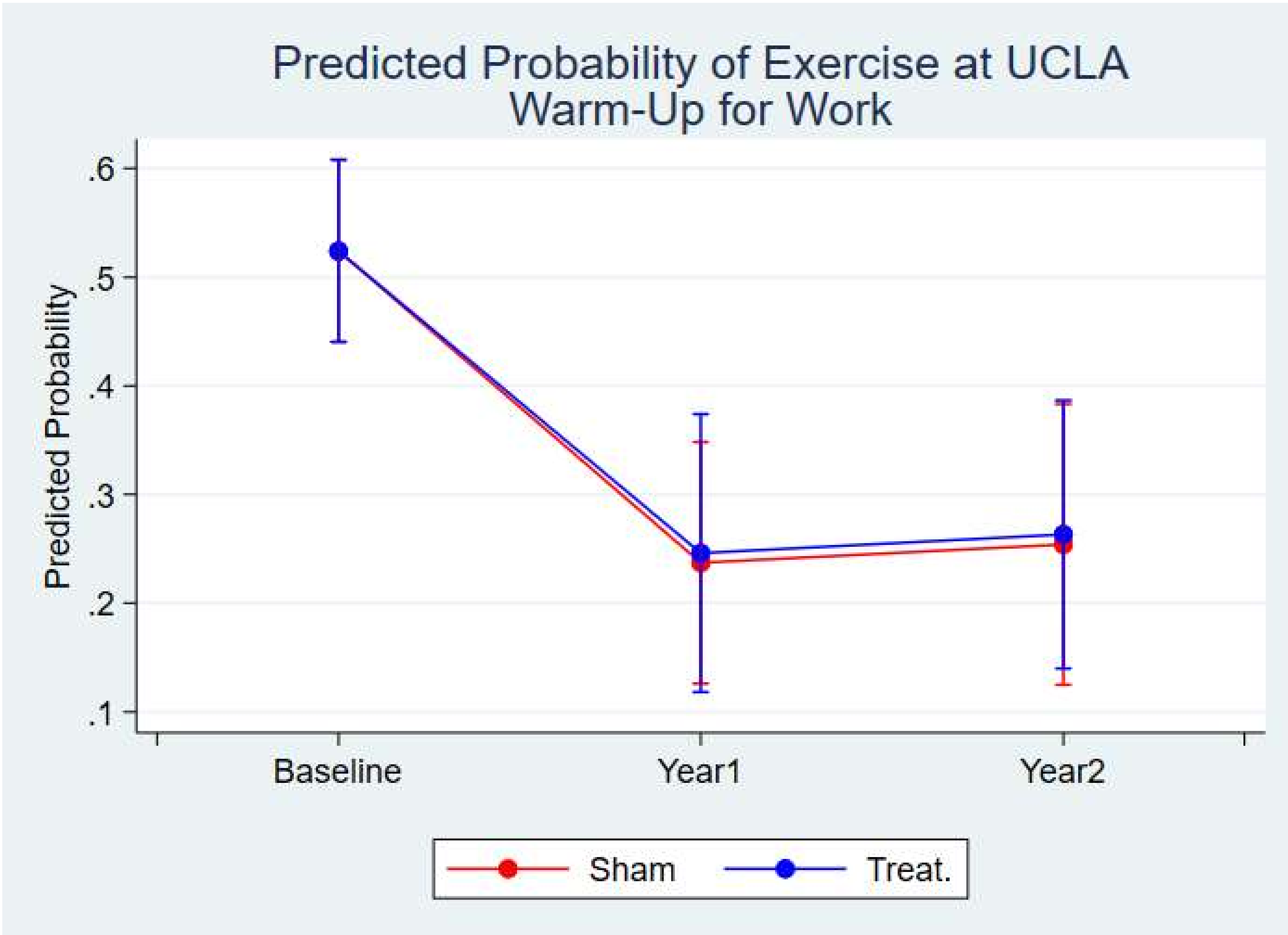
2. The predicted probability of reporting exercising at home within 2 hours of rising was 0.51 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting exercising at home within 2 hours of rising one year after the sham training was 0.42 (19% lower than baseline).
4. The predicted probability of sham subjects reporting exercising at home within 2 hours of rising two years after the sham training and one year after the treatment training was 0.49 (4% lower than baseline and 18% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting exercising at home within 2 hours of rising one year after the treatment training was 0.32 (38% lower than baseline).
6. The predicted probability of treatment subjects reporting exercising at home within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.49 (4% lower than baseline and 18% higher than one year after the second treatment training).

Table 18-13. Mixed Effects Logistic Regression for Exercise at UCLA Warm-Up for Work

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
UCLA "Warm up for work" Exercise					
Sex=Female	5.620	4.357	2.23	0.026	[1.230,25.685]
Age (Centered)	1.046	0.039	1.22	0.222	[0.973,1.124]
Number of lifts over 25 pounds/day	0.954	0.032	-1.40	0.162	[0.893,1.019]
Tenure	1.100	0.054	1.93	0.054	[0.998,1.212]
Shift=Night	2.216	1.701	1.04	0.300	[0.492,9.979]
Sleep Time (hrs) on Average per 24hrs	0.976	0.163	-0.15	0.882	[0.703,1.353]
Language (English or Spanish)=Spanish	2.096	1.466	1.06	0.290	[0.532,8.258]
Have More than UCLA Job=Yes	2.508	2.480	0.93	0.352	[0.361,17.421]
Stress level during past week=Some	1.310	0.805	0.44	0.660	[0.393,4.371]
Stress level during past week=Most	1.986	1.828	0.75	0.456	[0.327,12.060]
Sham Training (Lifting)=Impact 1yr After 1st Session	0.277	0.228	-1.56	0.119	[0.055,1.394]
Treatment Training (Bending)	0.305	0.115	-3.14	0.002	[0.146,0.640]
Survey=Year1	0.254	0.157	-2.22	0.027	[0.076,0.853]
Survey=Year2	1.000	0.000			
Intercept	0.366	0.520	-0.71	0.479	[0.023,5.925]
/					
var(_cons[idnum])	6.465	3.789			[2.050,20.390]

Table 18-14. Marginal Predicted Probability of Exercise at UCLA Warm-Up for Work

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.5241865	.0427005	12.28	0.000	.4404951	.607878
Sham@Year1	.2370574	.0567662	4.18	0.000	.1257977	.3483171
Sham@Year2	.2539287	.0660008	3.85	0.000	.1245695	.3832878
Treat.@Baseline	.5241865	.0427005	12.28	0.000	.4404951	.607878
Treat.@Year1	.2459502	.0653324	3.76	0.000	.1179011	.3739993
Treat.@Year2	.2631587	.0630016	4.18	0.000	.1396778	.3866396



1. Both the sham (lifting) and treatment (bending) training decreased the odds of participating in the UCLA "warm up for work" exercises (odds ratio, p, & [CI's]: 0.277, 0.119, [0.055,1.394] and 0.305, 0.002, [0.146,0.64], sham and treatment training respectively). This represents 72% decreased odds of reporting participating in the UCLA "warm up for work" exercises for sham subjects receiving the sham (lifting) training and 70% decreased odds of reporting participating in the UCLA "warm up for work" exercises for the treatment training (bending)

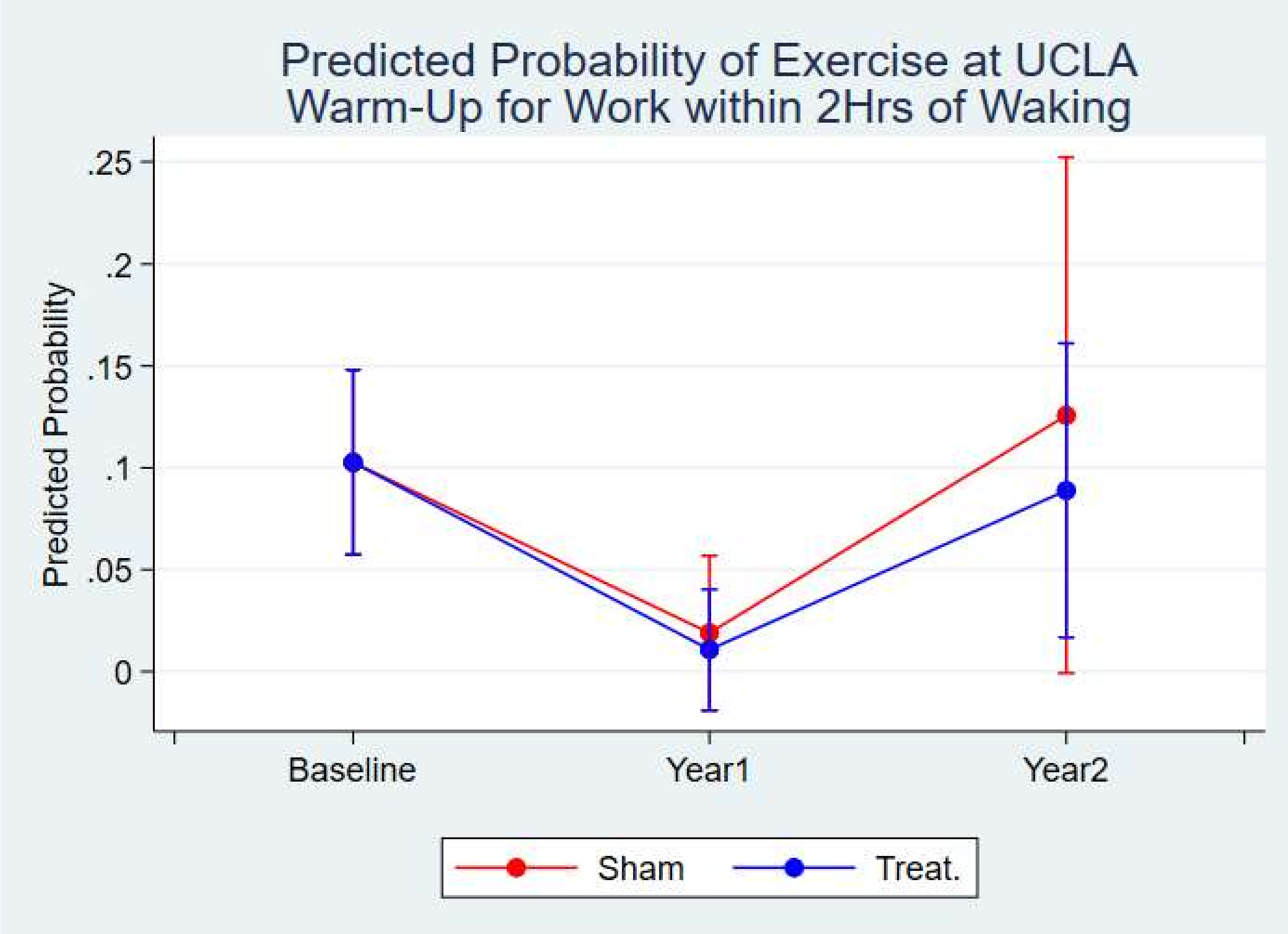
over the course of the study.
2. The predicted probability of reporting participating in the UCLA "warm up for work" exercises was 0.52 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises one year after the sham training was 0.24 (55% lower than baseline).
4. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises two years after the sham training and one year after the treatment training was 0.25 (52% lower than baseline and 7% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises one year after the treatment training was 0.25 (53% lower than baseline).
6. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises two years after the first treatment training and one year after the second treatment training was 0.25 (52% lower than baseline and 7% higher than one year after the second treatment training).

Table 18-15. Mixed Effects Logistic Regression for Exercise at UCLA Warm-Up for Work within 2 Hours of Waking

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
UCLA Exercise Within 2hrs of Rising					
Sex=Female	0.884	0.939	-0.12	0.908	[0.110,7.089]
Age (Centered)	1.054	0.069	0.80	0.422	[0.927,1.197]
Number of lifts over 25 pounds/day	0.971	0.055	-0.52	0.606	[0.869,1.085]
Tenure	1.021	0.083	0.26	0.795	[0.870,1.199]
Shift=Night	0.005	0.013	-2.19	0.029	[0.000,0.577]
Sleep Time (hrs) on Average per 24hrs	1.009	0.351	0.02	0.980	[0.510,1.996]
Language (English or Spanish)=Spanish	4.083	4.815	1.19	0.233	[0.405,41.178]
Have More than UCLA Job=Yes	2.371	4.099	0.50	0.618	[0.080,70.236]
Stress level during past week=Some	2.099	2.500	0.62	0.533	[0.203,21.666]
Stress level during past week=Most	36.695	61.681	2.14	0.032	[1.361,989.446]
Sham Training (Lifting)=Impact 1yr After 1st Session	1.980	2.967	0.46	0.648	[0.105,37.311]
Treatment Training (Bending)	0.843	0.441	-0.33	0.744	[0.302,2.352]
Survey=Year1	0.020	0.050	-1.56	0.119	[0.000,2.752]
Survey=Year2	1.000	0.000			
Intercept	0.176	0.453	-0.67	0.500	[0.001,27.407]
/					
var(_cons[idnum])	3.434	5.560			[0.144,82.036]

Table 18-16. Marginal Predicted Probability of Exercise at UCLA Warm-Up for Work within 2 Hours of Waking

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.1026421	.0231114	4.44	0.000	.0573446	.1479395
Sham@Year1	.0189407	.0193465	0.98	0.328	-.0189778	.0568591
Sham@Year2	.125698	.0645529	1.95	0.052	-.0008235	.2522194
Treat.@Baseline	.1026421	.0231114	4.44	0.000	.0573446	.1479395
Treat.@Year1	.0107146	.0150894	0.71	0.478	-.0188601	.0402893
Treat.@Year2	.088882	.0368596	2.41	0.016	.0166386	.1611255



1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of participating in the UCLA "warm up for work" exercises within 2 hours of rising (odds ratio, p, & [CI's]: 1.98, 0.648, [0.105,37.311] and 0.843, 0.744, [0.302,2.352], sham and treatment training respectively). This represents 98% increased odds of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising for sham subjects receiving the sham (lifting) training and 16% decreased odds of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising for the treatment training (bending) over the course of the study.

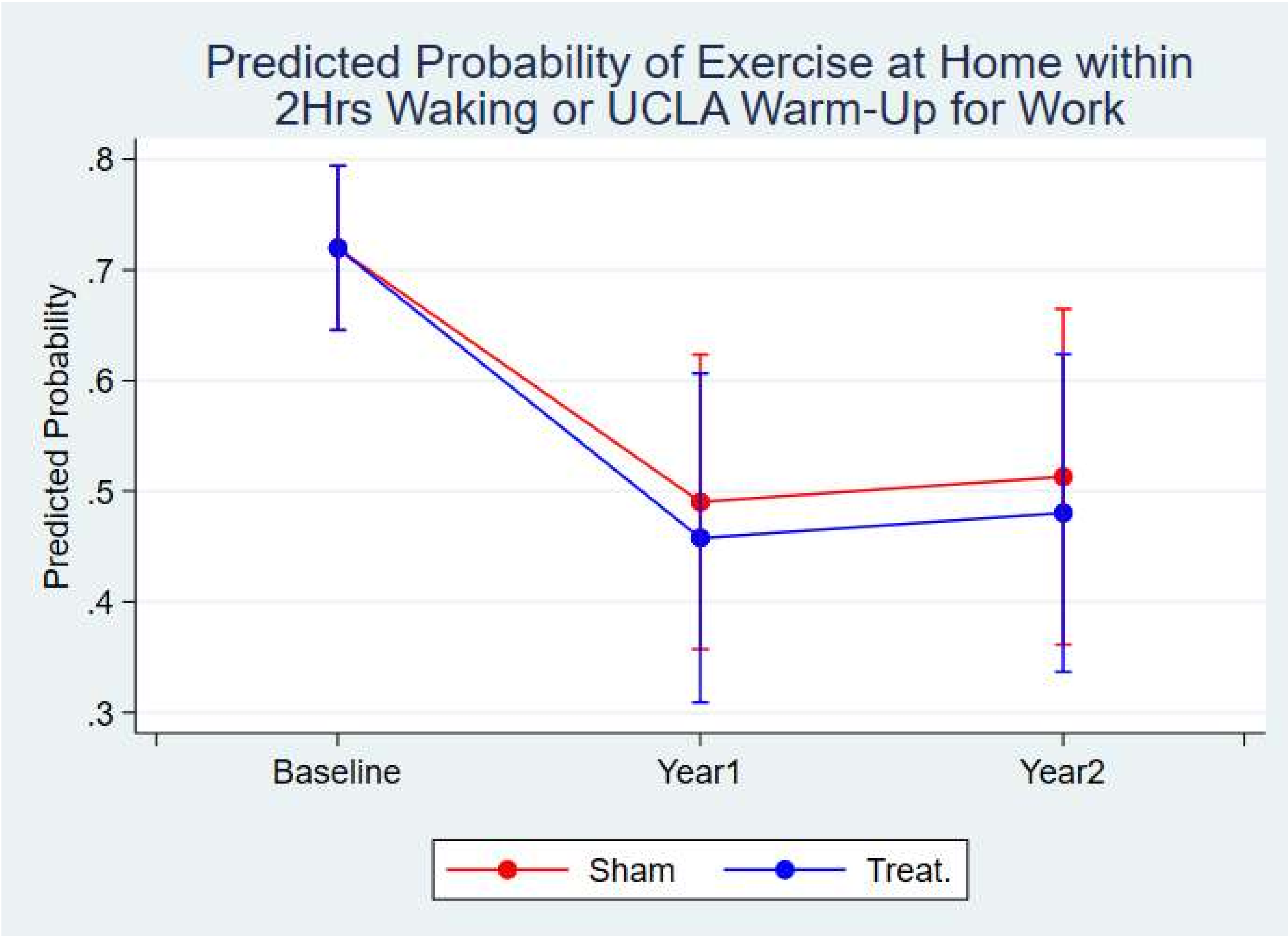
2. The predicted probability of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising was 0.1 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising one year after the sham training was 0.02 (82% lower than baseline).
4. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising two years after the sham training and one year after the treatment training was 0.13 (22% higher than baseline and 564% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising one year after the treatment training was 0.01 (90% lower than baseline).
6. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.13 (22% higher than baseline and 564% higher than one year after the second treatment training).

Table 18-17. Mixed Effects Logistic Regression for Exercise at Home within 2 Hours of Waking or UCLA Warm-Up for Work

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
UCLA or Exercise at Home					
Sex=Female	1.107	0.520	0.22	0.829	[0.441,2.780]
Age (Centered)	1.058	0.028	2.17	0.030	[1.005,1.113]
Number of lifts over 25 pounds/day	0.958	0.022	-1.90	0.057	[0.917,1.001]
Tenure	1.071	0.036	2.03	0.043	[1.002,1.144]
Shift=Night	2.070	1.083	1.39	0.165	[0.742,5.774]
Sleep Time (hrs) on Average per 24hrs	1.062	0.132	0.48	0.630	[0.832,1.354]
Language (English or Spanish)=Spanish	1.318	0.649	0.56	0.575	[0.502,3.460]
Have More than UCLA Job=Yes	12.021	10.086	2.96	0.003	[2.321,62.251]
Stress level during past week=Some	0.767	0.348	-0.59	0.558	[0.315,1.865]
Stress level during past week=Most	1.037	0.688	0.06	0.956	[0.283,3.805]
Sham Training (Lifting)=Impact 1yr After 1st Session	0.557	0.290	-1.12	0.262	[0.200,1.548]
Treatment Training (Bending)	0.453	0.121	-2.98	0.003	[0.269,0.763]
Survey=Year1	0.393	0.171	-2.15	0.031	[0.168,0.920]
Survey=Year2	1.000	0.000			
Intercept	1.690	1.678	0.53	0.597	[0.241,11.834]
/					
var(_cons[idnum])	1.989	1.243			[0.585,6.770]

Table 18-18. Marginal Predicted Probability of Exercise at Home within 2 Hours of Waking or UCLA Warm-Up for Work

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.7197625	.037792	19.05	0.000	.6456915	.7938334
Sham@Year1	.4901914	.0680776	7.20	0.000	.3567616	.6236211
Sham@Year2	.5129565	.0774396	6.62	0.000	.3611776	.6647353
Treat.@Baseline	.7197625	.037792	19.05	0.000	.6456915	.7938334
Treat.@Year1	.4575207	.0759532	6.02	0.000	.3086552	.6063862
Treat.@Year2	.4802036	.0733547	6.55	0.000	.336431	.6239762



1. Both the sham (lifting) and treatment (bending) training decreased the odds of exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises (odds ratio, p, & [CI's]: 0.557, 0.262, [0.2,1.548] and 0.453, 0.003, [0.269,0.763], sham and treatment training respectively). This represents 44% decreased odds of reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises for sham subjects receiving the sham (lifting) training and 55% decreased odds of reporting

exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises for the treatment training (bending) over the course of the study.

2. The predicted probability of reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises was 0.72 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises one year after the sham training was 0.49 (32% lower than baseline).

4. The predicted probability of sham subjects reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises two years after the sham training and one year after the treatment training was 0.51 (29% lower than baseline and 5% higher than one year after the sham training).

5. The predicted probability of treatment subjects reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises one year after the treatment training was 0.46 (36% lower than baseline).

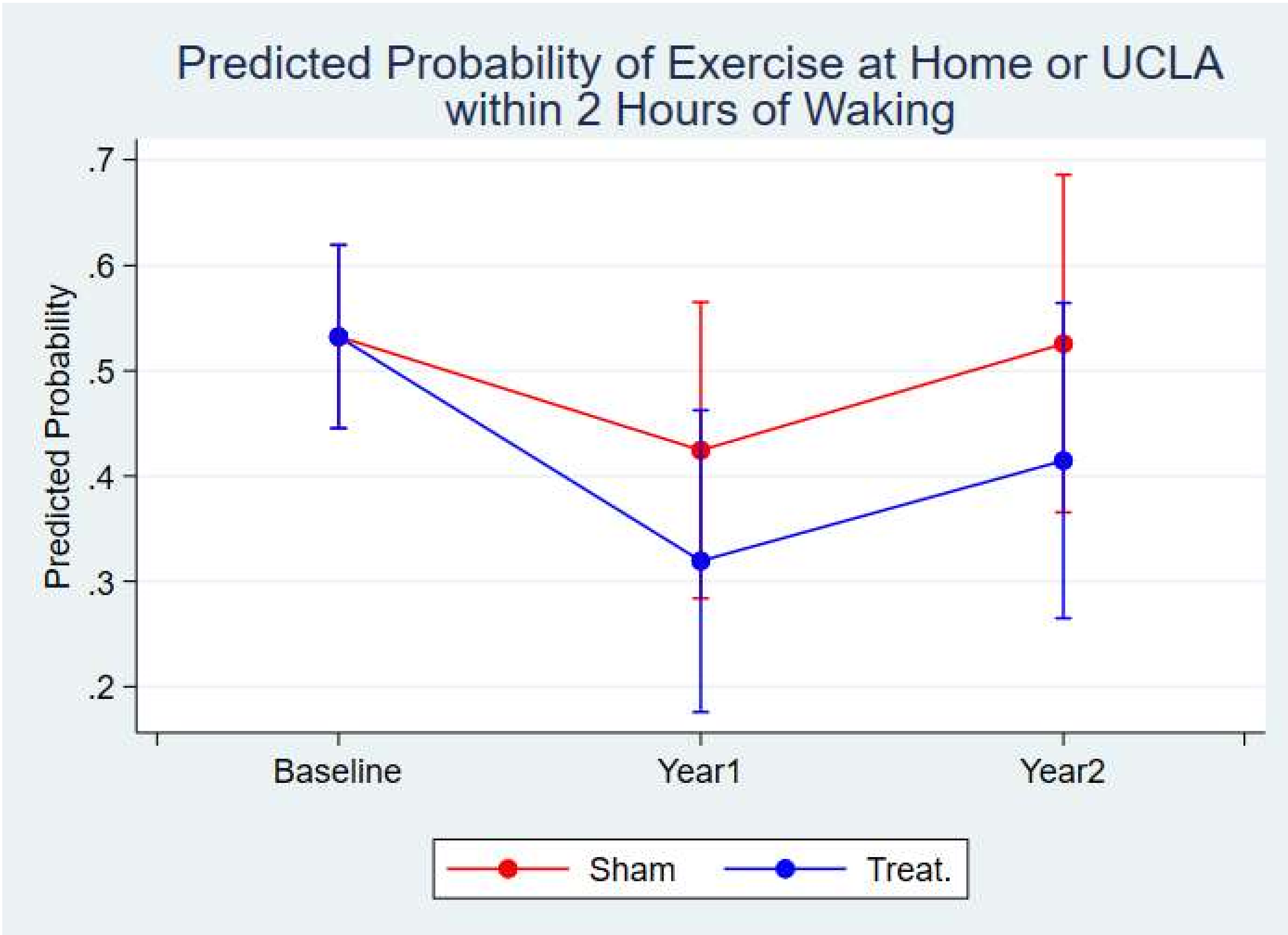
6. The predicted probability of treatment subjects reporting exercising at home within 2 hours of rising or participating in the UCLA "warm up for work" exercises two years after the first treatment training and one year after the second treatment training was 0.51 (29% lower than baseline and 5% higher than one year after the second treatment training).

Table 18-19. Mixed Effects Logistic Regression for Exercise at Home or UCLA within 2 Hours of Waking

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Exercise Home or UCLA within 2hrs Rising					
Sex=Female	1.152	0.492	0.33	0.739	[0.499,2.660]
Age (Centered)	1.052	0.025	2.12	0.034	[1.004,1.103]
Number of lifts over 25 pounds/day	0.984	0.020	-0.80	0.426	[0.945,1.024]
Tenure	1.011	0.030	0.37	0.715	[0.954,1.071]
Shift=Night	0.806	0.381	-0.46	0.648	[0.319,2.036]
Sleep Time (hrs) on Average per 24hrs	1.196	0.149	1.43	0.151	[0.937,1.526]
Language (English or Spanish)=Spanish	0.981	0.444	-0.04	0.966	[0.404,2.384]
Have More than UCLA Job=Yes	3.592	2.303	1.99	0.046	[1.022,12.619]
Stress level during past week=Some	0.573	0.246	-1.30	0.194	[0.247,1.327]
Stress level during past week=Most	1.631	1.024	0.78	0.436	[0.477,5.581]
Sham Training (Lifting)=Impact 1yr After 1st Session	1.348	0.638	0.63	0.528	[0.533,3.407]
Treatment Training (Bending)	0.714	0.173	-1.39	0.163	[0.444,1.147]
Survey=Year1	0.400	0.171	-2.14	0.032	[0.173,0.925]
Survey=Year2	1.000	0.000			
Intercept	0.457	0.451	-0.79	0.427	[0.066,3.163]
/					
var(_cons[idnum])	1.720	1.149			[0.464,6.367]

Table 18-20. Marginal Predicted Probability of Exercise at Home or UCLA within 2 Hours of Waking

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.5324115	.0444122	11.99	0.000	.4453653	.6194578
Sham@Year1	.4244784	.0717814	5.91	0.000	.2837896	.5651673
Sham@Year2	.5256209	.0817222	6.43	0.000	.3654483	.6857935
Treat.@Baseline	.5324115	.0444122	11.99	0.000	.4453653	.6194578
Treat.@Year1	.3193838	.073005	4.37	0.000	.1762967	.462471
Treat.@Year2	.4146471	.076405	5.43	0.000	.2648961	.5643982



1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising (odds ratio, p, & [CI's]: 1.348, 0.528, [0.533,3.407] and 0.714, 0.163, [0.444,1.147], sham and treatment training respectively). This represents 35% increased odds of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising for sham subjects receiving the sham (lifting) training and 29% decreased odds

of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising for the treatment training (bending) over the course of the study.
2. The predicted probability of reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising was 0.53 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising one year after the sham training was 0.42 (20% lower than baseline).
4. The predicted probability of sham subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising two years after the sham training and one year after the treatment training was 0.53 (1% lower than baseline and 24% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising one year after the treatment training was 0.32 (40% lower than baseline).
6. The predicted probability of treatment subjects reporting participating in the UCLA "warm up for work" exercises within 2 hours of rising or participating in the UCLA "warm up for work" exercises within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.53 (1% lower than baseline and 24% higher than one year after the second treatment training).

Table 18-21. Mixed Effects Ordered Logistic Regression for 7 Levels of Activity-Exercise

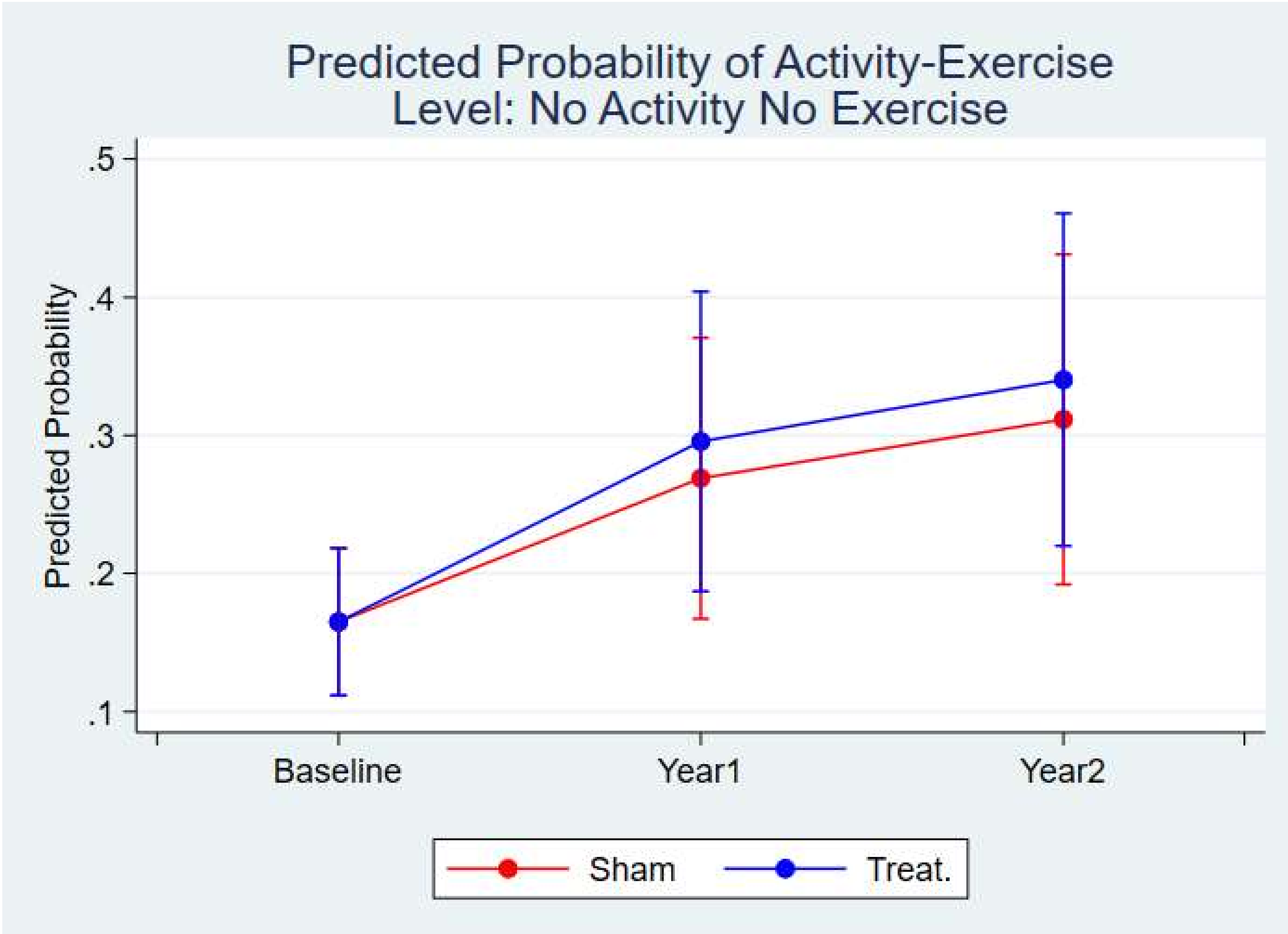
	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Activity-Exercise Levels within 2Hrs Rising					
Sex=Female	1.060	0.332	0.19	0.852	[0.574,1.958]
Age (Centered)	1.028	0.017	1.63	0.104	[0.994,1.062]
Number of lifts over 25 pounds/day	0.999	0.016	-0.06	0.949	[0.968,1.031]
Tenure	0.995	0.021	-0.23	0.821	[0.954,1.038]
Shift=Night	0.715	0.248	-0.97	0.334	[0.362,1.412]
Sleep Time (hrs) on Average per 24hrs	0.902	0.079	-1.18	0.239	[0.759,1.071]
Language (English or Spanish)=Spanish	0.252	0.090	-3.87	0.000	[0.125,0.506]
Have More than UCLA Job=Yes	0.795	0.352	-0.52	0.605	[0.334,1.892]
Stress level during past week=Some	1.649	0.519	1.59	0.112	[0.890,3.055]
Stress level during past week=Most	2.572	1.166	2.08	0.037	[1.057,6.255]
Sham Training (Lifting)=Impact 1yr After 1st Session	0.652	0.227	-1.23	0.219	[0.330,1.289]
Treatment Training (Bending)	0.554	0.104	-3.14	0.002	[0.383,0.800]
Survey=Year1	0.717	0.211	-1.13	0.259	[0.403,1.278]
Survey=Year2	1.000	0.000			
/					
cut1	-3.123	0.729			[-4.552,-1.695]
cut2	-1.553	0.703			[-2.930,-0.176]
cut3	-0.881	0.699			[-2.251,0.488]
cut4	-0.298	0.700			[-1.669,1.074]
cut5	0.717	0.713			[-0.681,2.114]
cut6	1.409	0.732			[-0.026,2.844]
var(_cons[idnum])	0.847	0.495			[0.269,2.666]

1. Both the sham (lifting) and treatment (bending) training decreased the odds of higher levels of combinations of activity and exercise (home or UCLA within 2 hours of rising - 7 levels) (odds ratio, p, & [CI's]: 0.652, 0.219, [0.33,1.289] and 0.554, 0.002, [0.383,0.8], sham and treatment training respectively). This represents 35% decreased odds of reporting higher levels of combinations of activity and exercise (home or UCLA within 2 hours of rising - 7 levels) for sham subjects receiving the sham (lifting) training and 45% decreased odds of reporting higher levels of combinations of activity and exercise (home or UCLA within 2 hours of rising - 7 levels) for the treatment training (bending) over the course of the study.

Table 18-22. Marginal Predicted Probability of 7 Levels of Activity-Exercise

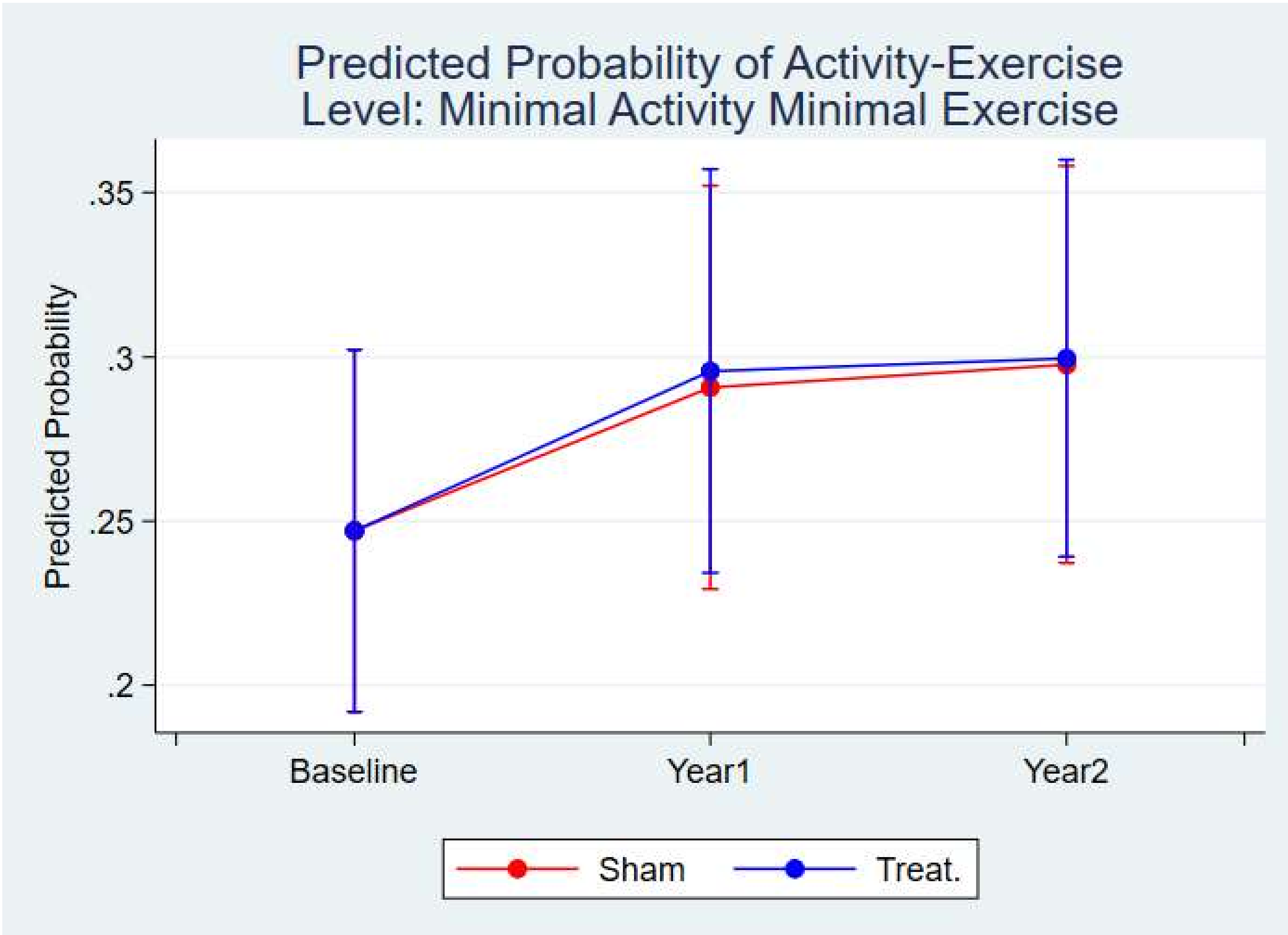
	Predict.Prob.	Std. error	z	p-value	95% CI	
No Activity/Exercise:Sham@Baseline	.1648367	.02724	6.05	0.000	.1114472	.2182261
No Activity/Exercise:Sham@Year1	.2688943	.0519609	5.17	0.000	.1670528	.3707359
No Activity/Exercise:Sham@Year2	.3115556	.0610382	5.10	0.000	.191923	.4311882
No Activity/Exercise:Treat.@Baseline	.1648367	.02724	6.05	0.000	.1114472	.2182261
No Activity/Exercise:Treat.@Year1	.2955709	.0554224	5.33	0.000	.1869449	.4041969
No Activity/Exercise:Treat.@Year2	.3402151	.0613924	5.54	0.000	.2198882	.460542
Min Activity Min Exercise:Sham@Baseline	.2470443	.0281037	8.79	0.000	.1919621	.3021265
Min Activity Min Exercise:Sham@Year1	.2907056	.0313204	9.28	0.000	.2293189	.3520924
Min Activity Min Exercise:Sham@Year2	.2976676	.0308415	9.65	0.000	.2372194	.3581158
Min Activity Min Exercise:Treat.@Baseline	.2470443	.0281037	8.79	0.000	.1919621	.3021265
Min Activity Min Exercise:Treat.@Year1	.2956681	.0313451	9.43	0.000	.2342328	.3571033
Min Activity Min Exercise:Treat.@Year2	.2995825	.0308205	9.72	0.000	.2391755	.3599896
Min Activity Exercise:Sham@Baseline	.1306147	.0219108	5.96	0.000	.0876703	.1735592
Min Activity Exercise:Sham@Year1	.1244744	.0215319	5.78	0.000	.0822727	.1666761
Min Activity Exercise:Sham@Year2	.118274	.0216218	5.47	0.000	.0758962	.1606519
Min Activity Exercise:Treat.@Baseline	.1306147	.0219108	5.96	0.000	.0876703	.1735592
Min Activity Exercise:Treat.@Year1	.1207506	.021472	5.62	0.000	.0786663	.1628349
Min Activity Exercise:Treat.@Year2	.1134734	.0213883	5.31	0.000	.071553	.1553937
Moderate Activity No Exercise:Sham@Baseline	.1104825	.020993	5.26	0.000	.0693369	.151628
Moderate Activity No Exercise:Sham@Year1	.0929045	.0193999	4.79	0.000	.0548813	.1309277
Moderate Activity No Exercise:Sham@Year2	.0846645	.0191368	4.42	0.000	.0471571	.1221719
Moderate Activity No Exercise:Treat.@Baseline	.1104825	.020993	5.26	0.000	.0693369	.151628
Moderate Activity No Exercise:Treat.@Year1	.0877602	.0191559	4.58	0.000	.0502154	.125305
Moderate Activity No Exercise:Treat.@Year2	.0791418	.0184982	4.28	0.000	.0428861	.1153975
Moderate Activity Exercise:Sham@Baseline	.1586662	.0262177	6.05	0.000	.1072805	.210052
Moderate Activity Exercise:Sham@Year1	.1152096	.0249628	4.62	0.000	.0662834	.1641358
Moderate Activity Exercise:Sham@Year2	.1002254	.0244001	4.11	0.000	.0524021	.1480486
Moderate Activity Exercise:Treat.@Baseline	.1586662	.0262177	6.05	0.000	.1072805	.210052
Moderate Activity Exercise:Treat.@Year1	.1056434	.0242842	4.35	0.000	.0580471	.1532396

Moderate Activity Exercise:Treat.@Year2	.0910773	.0227699	4.00	0.000	.0464492	.1357055
Hight Activity No Exercise:Sham@Baseline	.0747747	.0196479	3.81	0.000	.0362656	.1132838
Hight Activity No Exercise:Sham@Year1	.0468872	.0153591	3.05	0.002	.0167838	.0769906
Hight Activity No Exercise:Sham@Year2	.039007	.0136966	2.85	0.004	.0121622	.0658519
Hight Activity No Exercise:Treat.@Baseline	.0747747	.0196479	3.81	0.000	.0362656	.1132838
Hight Activity No Exercise:Treat.@Year1	.041778	.0142409	2.93	0.003	.0138662	.0696897
Hight Activity No Exercise:Treat.@Year2	.0345138	.0122794	2.81	0.005	.0104467	.0585809
High Activity Exercise:Sham@Baseline	.1135809	.0252101	4.51	0.000	.0641699	.1629919
High Activity Exercise:Sham@Year1	.0609244	.0205512	2.96	0.003	.0206448	.1012039
High Activity Exercise:Sham@Year2	.0486058	.0177367	2.74	0.006	.0138425	.0833691
High Activity Exercise:Treat.@Baseline	.1135809	.0252101	4.51	0.000	.0641699	.1629919
High Activity Exercise:Treat.@Year1	.0528289	.0186374	2.83	0.005	.0163003	.0893575
High Activity Exercise:Treat.@Year2	.0419961	.0154164	2.72	0.006	.0117805	.0722116



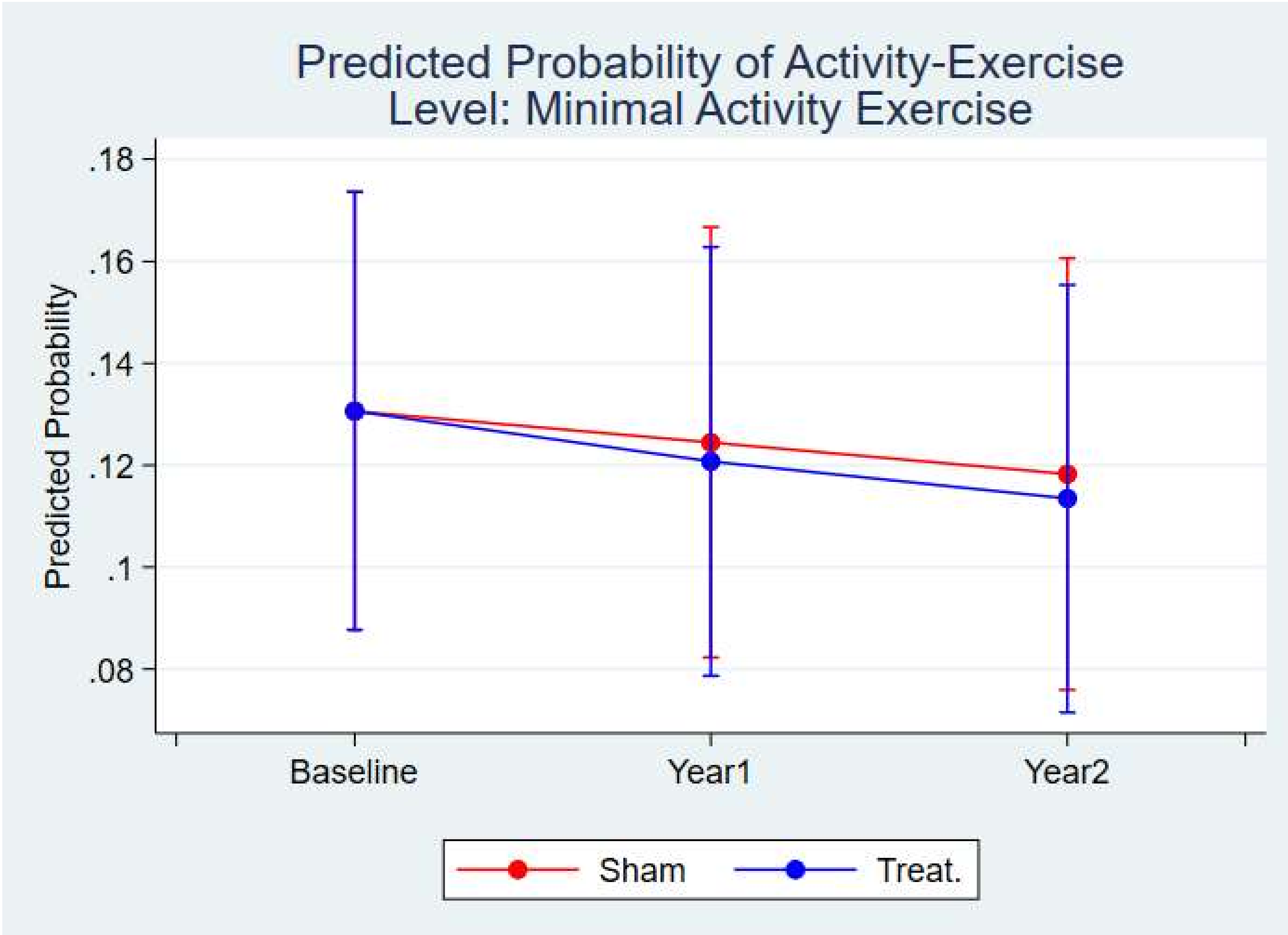
2. The predicted probability of reporting no activity or exercise within 2 hours of rising was 0.16 at baseline (for both sham and treatment

subjects).
3. The predicted probability of sham subjects reporting no activity or exercise within 2 hours of rising one year after the sham training was 0.27 (63% higher than baseline).
4. The predicted probability of sham subjects reporting no activity or exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.31 (89% higher than baseline and 16% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting no activity or exercise within 2 hours of rising one year after the treatment training was 0.30 (79% higher than baseline).
6. The predicted probability of treatment subjects reporting no activity or exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.31 (89% higher than baseline and 16% higher than one year after the second treatment training).



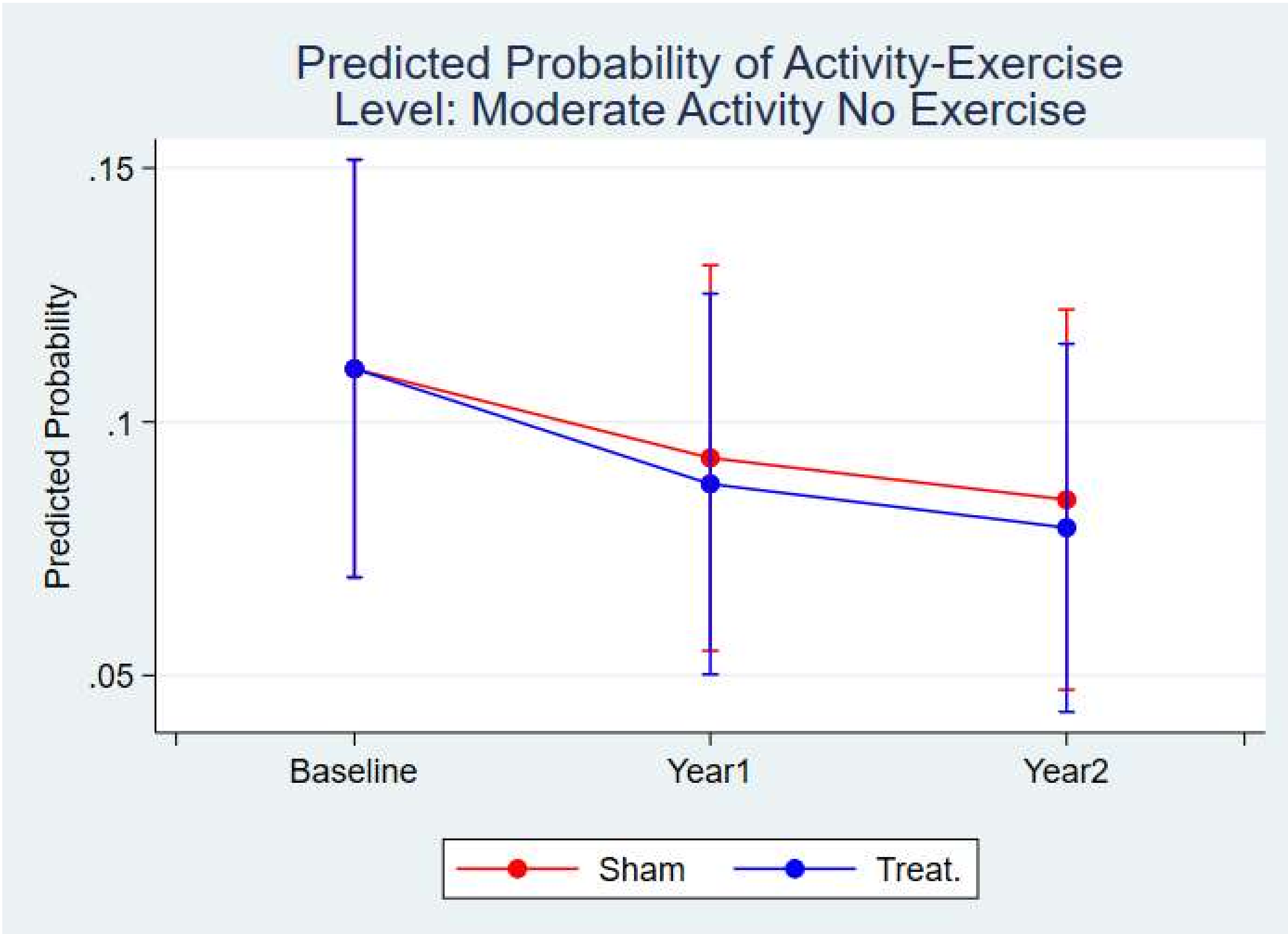
2. The predicted probability of reporting minimal activity and minimal exercise within 2 hours of rising was 0.25 at baseline (for both sham

and treatment subjects).
3. The predicted probability of sham subjects reporting minimal activity and minimal exercise within 2 hours of rising one year after the sham training was 0.29 (18% higher than baseline).
4. The predicted probability of sham subjects reporting minimal activity and minimal exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.3 (20% higher than baseline and 2% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting minimal activity and minimal exercise within 2 hours of rising one year after the treatment training was 0.30 (20% higher than baseline).
6. The predicted probability of treatment subjects reporting minimal activity and minimal exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.3 (20% higher than baseline and 2% higher than one year after the second treatment training).



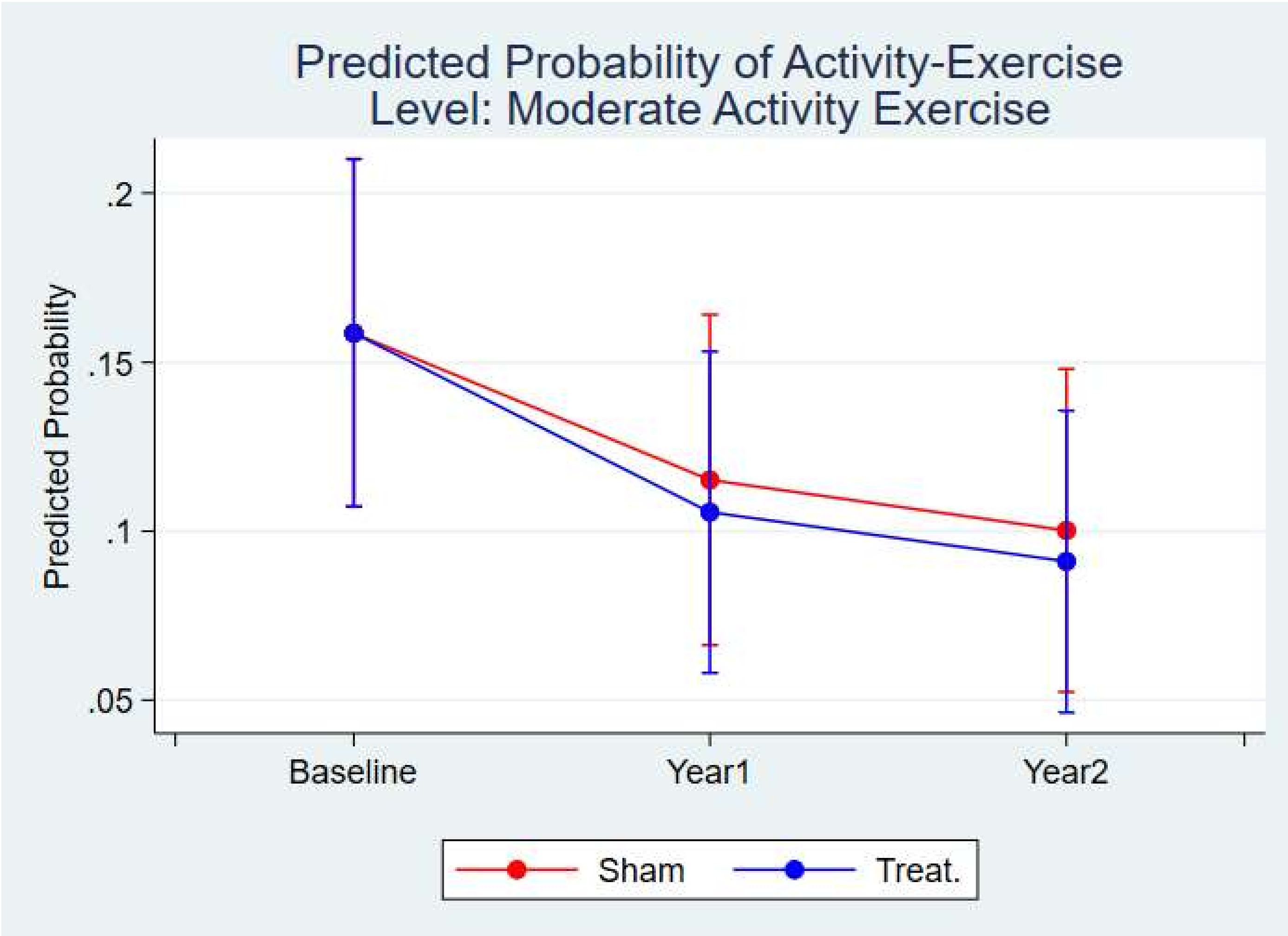
2. The predicted probability of reporting minimal activity and exercise within 2 hours of rising was 0.13 at baseline (for both sham and

treatment subjects).
3. The predicted probability of sham subjects reporting minimal activity and exercise within 2 hours of rising one year after the sham training was 0.12 (5% lower than baseline).
4. The predicted probability of sham subjects reporting minimal activity and exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.12 (9% lower than baseline and 5% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting minimal activity and exercise within 2 hours of rising one year after the treatment training was 0.12 (8% lower than baseline).
6. The predicted probability of treatment subjects reporting minimal activity and exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.12 (9% lower than baseline and 5% lower than one year after the second treatment training).



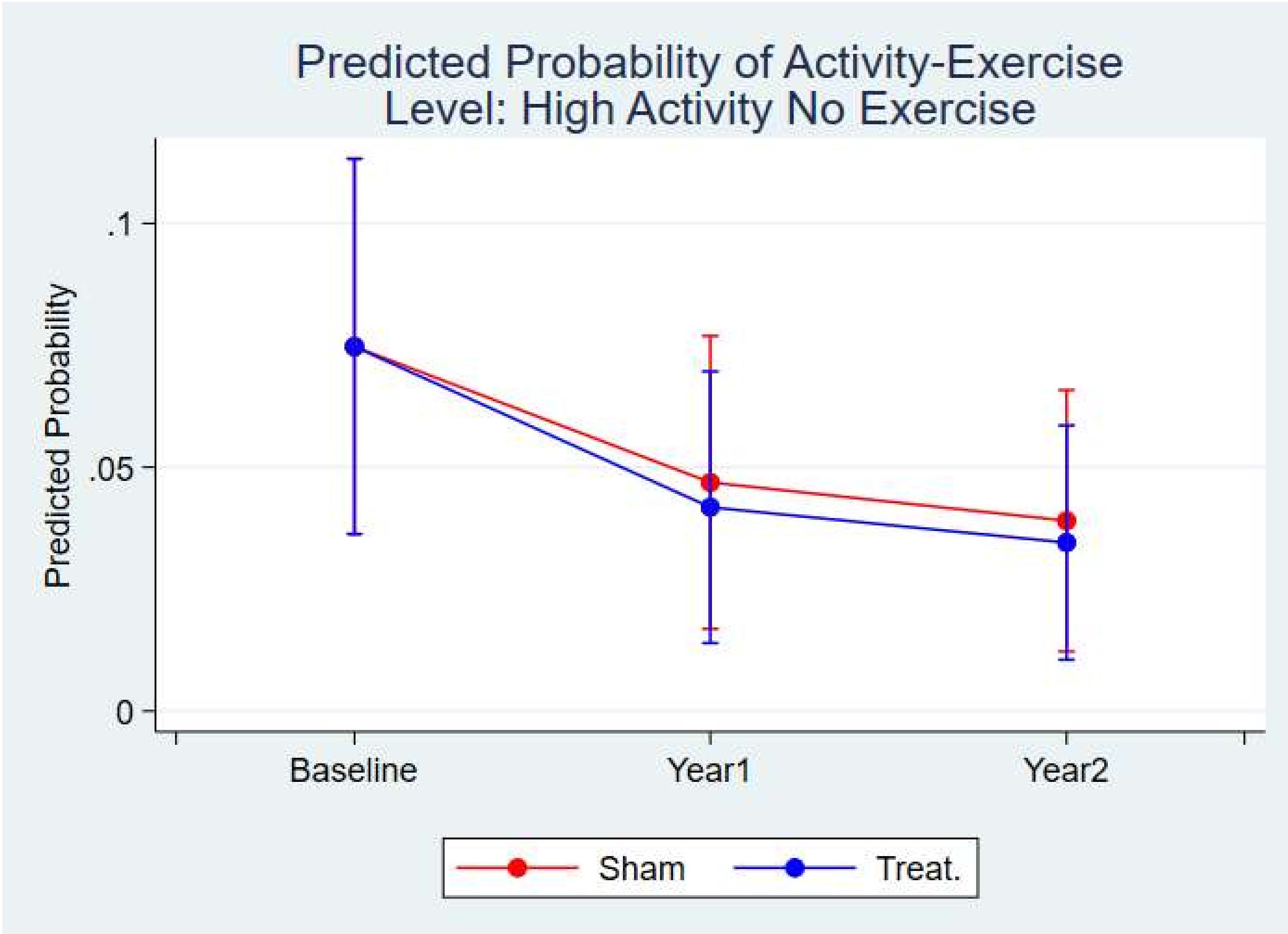
2. The predicted probability of reporting moderate activity and no exercise within 2 hours of rising was 0.11 at baseline (for both sham and

treatment subjects).
3. The predicted probability of sham subjects reporting moderate activity and no exercise within 2 hours of rising one year after the sham training was 0.09 (16% lower than baseline).
4. The predicted probability of sham subjects reporting moderate activity and no exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.08 (23% lower than baseline and 9% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting moderate activity and no exercise within 2 hours of rising one year after the treatment training was 0.09 (21% lower than baseline).
6. The predicted probability of treatment subjects reporting moderate activity and no exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.08 (23% lower than baseline and 9% lower than one year after the second treatment training).



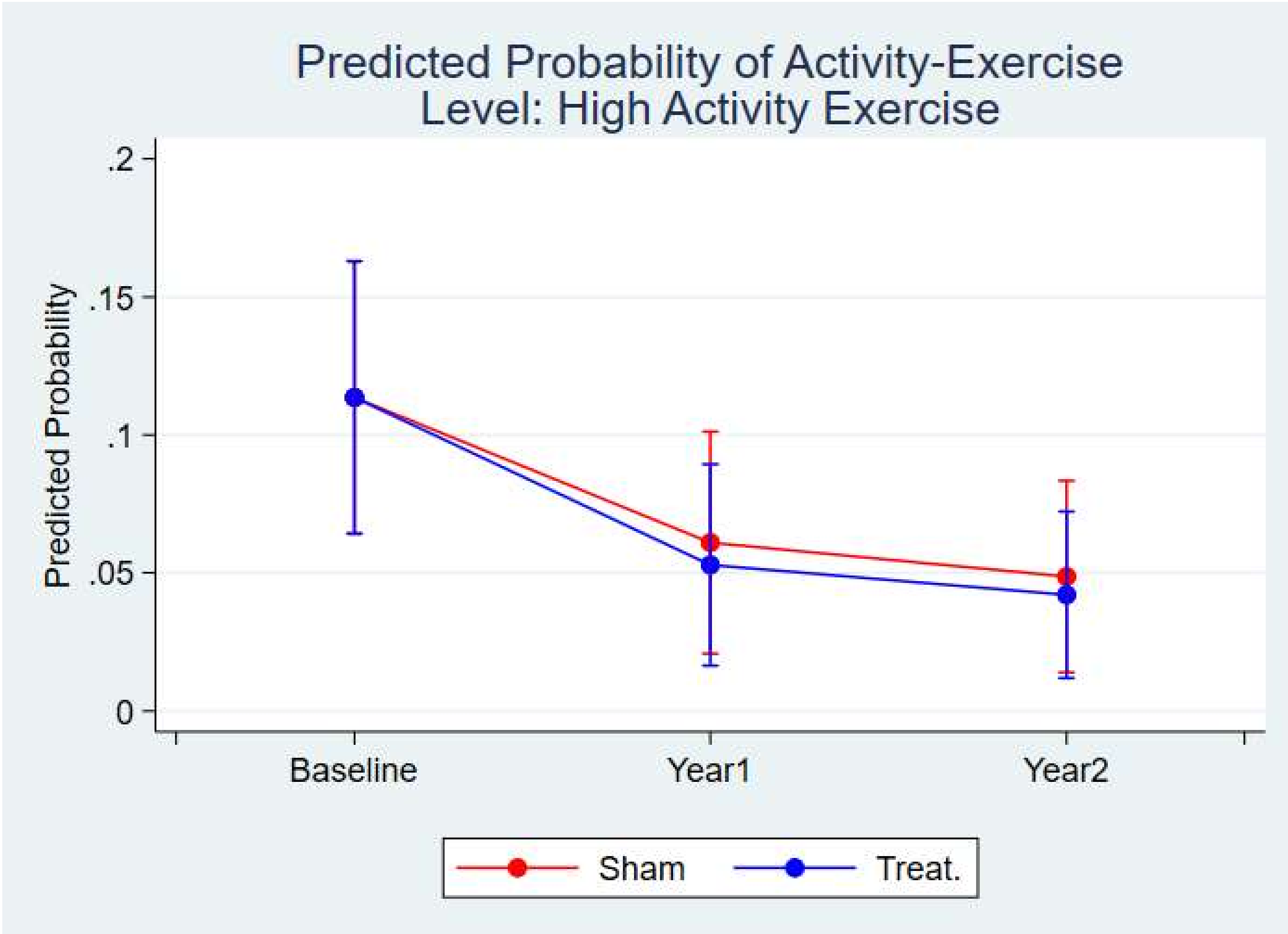
2. The predicted probability of reporting moderate activity and exercise within 2 hours of rising was 0.16 at baseline (for both sham and

treatment subjects).
3. The predicted probability of sham subjects reporting moderate activity and exercise within 2 hours of rising one year after the sham training was 0.12 (27% lower than baseline).
4. The predicted probability of sham subjects reporting moderate activity and exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.1 (37% lower than baseline and 13% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting moderate activity and exercise within 2 hours of rising one year after the treatment training was 0.11 (33% lower than baseline).
6. The predicted probability of treatment subjects reporting moderate activity and exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.1 (37% lower than baseline and 13% lower than one year after the second treatment training).



2. The predicted probability of reporting high activity and no exercise within 2 hours of rising was 0.07 at baseline (for both sham and

treatment subjects).
3. The predicted probability of sham subjects reporting high activity and no exercise within 2 hours of rising one year after the sham training was 0.05 (37% lower than baseline).
4. The predicted probability of sham subjects reporting high activity and no exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.04 (48% lower than baseline and 17% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting high activity and no exercise within 2 hours of rising one year after the treatment training was 0.04 (44% lower than baseline).
6. The predicted probability of treatment subjects reporting high activity and no exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.04 (48% lower than baseline and 17% lower than one year after the second treatment training).



2. The predicted probability of reporting high activity and exercise within 2 hours of rising was 0.11 at baseline (for both sham and treatment

subjects).
3. The predicted probability of sham subjects reporting high activity and exercise within 2 hours of rising one year after the sham training was 0.06 (46% lower than baseline).
4. The predicted probability of sham subjects reporting high activity and exercise within 2 hours of rising two years after the sham training and one year after the treatment training was 0.05 (57% lower than baseline and 20% lower than one year after the sham training).
5. The predicted probability of treatment subjects reporting high activity and exercise within 2 hours of rising one year after the treatment training was 0.05 (53% lower than baseline).
6. The predicted probability of treatment subjects reporting high activity and exercise within 2 hours of rising two years after the first treatment training and one year after the second treatment training was 0.05 (57% lower than baseline and 20% lower than one year after the second treatment training).

19 APPENDIX VI – SUPERVISOR’S INFORMATIONAL MEETING SCRIPT

(On Next Page)

Training Study to Reduce Back Pain

George Brogmus, a graduate student researcher at UCLA, is doing a research study on back pain. You and your employees can be part of this study because you work in Maintenance Services at UCLA. Please read the following to your employees when you hand out the Informational Flyer:

The flyer I am handing out is about a research study being done by a graduate student at UCLA. You can choose to be part of this study or not. There are no negative consequences for you no matter what you choose. It is very important for you to understand that you are free to participate or not.

The study is to see if a simple training session can help reduce back pain. The results of the study may help others to prevent or reduce back pain. There are no anticipated risks or discomforts if you participate. The study will begin next week.

If you have any questions about participating, contact Cindy Burt or George Brogmus.

20 APPENDIX VII – INFORMATIONAL FLYER (ENGLISH AND SPANISH)

(On Next Page)

Training Study to Reduce Back Pain

George Brogmus, a graduate student researcher at UCLA, is doing a research study on back pain. You can be part of this study because you work in Maintenance Services at UCLA. You can choose to be part of this study or not. There are no negative consequences for you no matter what you choose.

The study is to see if a simple training session can help reduce back pain. The results of the study may help others to prevent or reduce back pain. There are no anticipated risks or discomforts if you participate.

The study will begin next week. Your supervisor will tell you when. If you choose to participate in the study you will sign a consent agreement and fill out a survey. The survey will ask you questions about your experience with back pain. Your answers will be kept confidential.

After the survey you will receive a brief training session on back pain and how to reduce it. The survey and training will take about 30 minutes total. In about 6 months and again in about 1 year from now you will re-take the survey. You might also receive similar training.

If you have any questions about participating, contact Cindy Burt at UCLA Office of Environment, Health & Safety (310-794-5329) or George Brogmus (818-955-9995)

Estudio de Formación Para Reducir el Dolor de Espalda

George Brogmus, es un investigador estudiante de postgrado en la UCLA. Él está haciendo un estudio de investigación sobre el dolor de espalda. Usted puede ser parte de este estudio porque usted trabaja en el Servicio de Mantenimiento de la UCLA. Usted puede optar por ser parte de este estudio o no. No existen ningunas consecuencias negativas para usted, no importa lo que usted elija.

El estudio es para ver si una simple sesión de entrenamiento puede ayudar a reducir el dolor de espalda. Los resultados del estudio pueden ayudar a otras personas a prevenir o a reducir el dolor de espalda. No hay riesgos previstos o molestias si usted participa.

El estudio se iniciará la próxima semana. Su supervisor le dirá cuándo. Si usted decide participar en el estudio usted tendrá que firmar un acuerdo de consentimiento y llenar una encuesta. La encuesta le hará preguntas acerca de su experiencia con el dolor de espalda. Sus respuestas serán confidenciales.

Después de la encuesta, usted recibirá una breve sesión de entrenamiento acerca del dolor de espalda y cómo reducirlo. La encuesta y el entrenamiento duran unos 30 minutos en total. En unos 6 meses y de nuevo alrededor de 1 año a partir de ahora, usted volverá a participar en la encuesta. También podría recibir una formación similar.
Si usted tiene alguna pregunta acerca de la participación, póngase en contacto con Cindy Burt en la oficina del Medio Ambiente, Salud y Seguridad de UCLA (310-794-5329) o con George Brogmus (818-955-9995).

21 APPENDIX VIII – SCRIPT FOR INFORMED CONSENT MEETING

(On Next Page)

Script Points for Consent Meeting

1. This study is to see if a simple training session can help reduce back pain – both to prevent it from happening and to reduce any existing back pain.
2. You are free to participate or not, without any strings attached.
3. There are no anticipated risks or discomforts for you if you participate.
4. Your part will simply be to fill out a written survey and receive the training. You will re-take the survey in 6 months and perhaps again in a year.
5. Any question that you do not want to answer on the survey you can simply leave blank.
6. All the survey information will be confidential. Please do NOT put your name anywhere except the first page. We will replace your name with a random code so that the researchers will not know any individual's information. None of your survey data will be shared with anyone in the maintenance department.
7. Your total work hours worked per month and information from any workers' compensation claims you have had during the past three years will also be used in this research, but will also remain confidential.
8. The data from this study might get used in other research in the future, but your survey responses and other data will remain confidential.
9. Your participation is important and valuable. This research is important because back pain affects most people sometime in their lives and it is painful, can be frightening, and can keep people from doing everyday activities and work. Anything that might help to prevent or reduce back pain has the potential to help a lot of people reduce or eliminate significant pain and suffering.
10. Thank-you!

22 APPENDIX IX – INFORMED CONSENT FORMS (ENGLISH AND SPANISH)

(On Next Page)

English Version Informed Consent Form

Workplace Training to Reduce Back Pain

Overview

You are asked to participate in a research study conducted by George Brogmus, graduate student researcher, at the University of California, Los Angeles. You were selected as a possible participant in this study because you work in Maintenance Services at UCLA. Your participation in this research study is voluntary. This study is to see if a simple training session can help reduce back pain – both to prevent it from occurring and to reduce any existing back pain. The results of the research may help others to prevent and/or reduce back pain. There are no anticipated risks or discomforts.

If you choose to participate you will:

- Complete a brief survey now, again after approximately 6 months, and again after about one year. The survey will take about 10 minutes to complete.
- Receive one or two brief training sessions between now and about 6 months from now. Each training session will last about 20 minutes.

Both the survey and training will take place during your paid working time.

Confidentiality

Any information that is obtained in connection with this study and that can identify you will remain confidential. It will be disclosed only with your permission or as required by law. Confidentiality will be maintained by coding your identifying information (name and employee number) into a random code, for which a key will be kept confidential. If you choose to allow it, data from this study may be used in future research, but your information will remain confidential as described above.

Additional Information to be Used in Analysis

Your total hours worked per month will be used in the data analysis. Also, the count, cost and any days away from work for any UCLA workers' compensation claims you have had in the previous two years and any during the study period will be used in the data analysis. These workers' compensation data will be kept confidential – only the random code will be used in the analysis.

Voluntary Participation

You can choose whether or not you want to be in this study. Participation will not affect your relationship to UCLA in any way, including your employment or employability. Your supervisor will not know if you participated or not. You may withdraw your consent at any time and discontinue participation without penalty or loss of benefits to which you were otherwise entitled. If you volunteer to be in this study, you may leave the study at any time without consequences of any kind. You are not waiving any of your legal rights if you choose to be in this research study. You may refuse to answer any questions that you do not want to answer and still remain in the study.

Questions?

If you have any questions, comments or concerns about the research, you can talk to the graduate student researcher (818-955-9995) or to Cindy Burt, UCLA EH&S Injury Prevention Division Manager (310-794-5329).

If you wish to ask questions about your rights as a research participant or if you wish to voice any problems or concerns you may have about the study to someone other than the researchers, please call the Office of the Human Research Protection Program at (310) 825-7122 or write to Office of the Human Research Protection Program, UCLA, 11000 Kinross Avenue, Suite 102, Box 951694, Los Angeles, CA 90095-1694.

SIGNATURE OF STUDY PARTICIPANT

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

Check Only One of the following:

☐ I agree to let the researchers use my data for future research.

☐ I do NOT agree to let the researchers use my data for future research.

____
Name of Participant

______________________________________ ______________________
Signature of Participant **Date**

SPANISH VERSION INFORMED CONSENT FORM

Capacitación Laboral Para Reducir el Dolor de Espalda

Información General

Usted está invitado a participar en un estudio de investigación llevado a cabo por George Brogmus, investigador estudiante de postgrado de la UCLA Fielding School of Public Health. Usted ha sido seleccionado como posible participante en éste estudio porque usted trabaja en el Servicio de Mantenimiento de la UCLA. Su participación en éste estudio de investigación es voluntaria. Este estudio es para ver si una simple sesión de entrenamiento puede ayudar a reducir el dolor de espalda – y también para evitar que se produzca, y/o para reducir cualquier dolor de espalda ya existente. Los resultados de la investigación pueden ayudar a otros a prevenir y / o reducir el dolor de espalda. No hay riesgos previstos o molestias.

Si usted decide participar, usted:

- Completará una breve encuesta ahora, y de nuevo aproximadamente después de 6 meses, y más adelante después de un año. La encuesta durará aproximadamente 10 minutos para ser completada.

- Recibirá una o dos sesiones de capacitación breves entre hoy y cerca de 6 meses a partir de ahora. Cada sesión de entrenamiento tendrá una duración de unos 20 minutos.

Tanto el estudio y la formación se llevará a cabo durante su tiempo de trabajo remunerado.

La Confidencialidad

Cualquier información que se obtiene en relación con éste estudio y que lo pueda identificar a usted, se mantendrá confidencial. La confidencialidad se mantendrá mediante la codificación de su información de identificación (nombre y número del empleado) en un código aleatorio, por lo que una llave se mantendrá confidencial. Los datos de éste estudio pueden ser utilizados en futuras investigaciones, pero su información se mantendrá confidencial, como se ha descrito anteriormente. Nadie fuera del grupo de investigación tendrá el acceso a cualquiera de la información que tiene cualquier información de identificación en ello.

La Información Adicional Que se Empleará en el Análisis

Sus horas totales trabajadas por mes se utilizarán en el análisis de datos. Además, el recuento, el costo y los días fuera del trabajo por cualquier tipo de reclamo a la compensación al trabajador de la UCLA que haya tenido en los últimos tres años y que se realicen durante el período de estudio se utilizará en el análisis de datos. Estos datos de compensación al trabajador también se mantendrán en confidencialidad.

La Participación es Voluntaria

Usted puede elegir si desea o no participar en este estudio. La participación no afectará su relación con UCLA en ninguna manera, incluyendo su empleo. Usted puede retirar este estudio en cualquier momento e interrumpir su participación sin penalización ni pérdida de beneficios a los que tenía derecho de otra manera. Si usted es voluntario para participar en éste estudio, usted puede retirarse del estudio en cualquier momento y sin consecuencias de ningún tipo. Usted no está renunciando a ninguno de sus derechos legales si decide participar en éste estudio de investigación. Usted puede negarse a contestar cualquier pregunta que usted no quiera contestar y aún así permanecer en el estudio.

¿Preguntas?

Si usted tiene alguna pregunta, comentario o inquietud acerca de la investigación, usted puede hablar con el investigador estudiante de postgrado (818-955-9995) o con Cindy Burt, UCLA EH&S Injury Prevention Division Manager (310-794-5329).

Si desea hacer preguntas sobre sus derechos como participante de una investigación o si se desea expresar algún problema o inquietud que tenga sobre el estudio a una persona distinta a los investigadores, por favor llame a la Oficina del Programa de Investigación de Protección Humana al (310) 825-7122 o escribir a la Oficina del Programa de Investigación de Protección Humana de UCLA, (Office of the Human Research Protection Program, UCLA) 11000 Kinross Avenue, Suite 102, Box 951694, Los Angeles, CA 90095-1694.

FIRMA DEL PARTICIPANTE DEL ESTUDIO

Firmando abajo entiendo los procedimientos descritos anteriormente. Mis preguntas han sido contestadas a mi satisfacción, y me comprometo a participar en éste estudio - y deje a los investigadores usar mis datos para la futura investigación.. A mí me han dado una copia de este formulario.

____

Nombre del Participante

______________________________________ ______________________

Firma del Participante **FECHA**

23 APPENDIX X – POWERPOINT TRAINING SCRIPTS

(On Next Page)

PowerPoint Training Scripts

Common to Both Sham (lifting) and Treatment (Bending Control) Sessions

In our session today we are going to be focusing on how to lift safely as an important way to reduce back pain – both to prevent it and to help you recover once you get it..

We'll start by reviewing how big the back pain problem is

and briefly review the causes of back pain

and talk about the fact that most back pain goes away by itself.

We'll talk about what you can do to deal with back pain when you get it and how you can help prevent it.

Then we'll get into the details of why lifting safely is so important and exactly how to lift safely.

Back pain can be mild or hurt really bad. When back pain is really bad, it can be frightening. It may seem like something is very wrong.

The truth is almost all of us get back pain sometime in our lives – up to 80% of us. Once we've had it, we will probably get it again.

Over 25 out of 100 people in the US report at least one day of back pain within any three month period of time.

One out of 10 report ongoing problems doing things because of back pain.

There seems to be as many people with back pain now as there was years ago. But the costs of back pain continue to go up. Medical costs alone are greater than all forms of cancer combined! When all costs are taken into account, such as lost productivity, time off work, and medical expenses, the total cost of back pain to the US is over $500 Billion dollars!

The good news is that in the vast majority of cases, back pain is not serious and goes away quickly without medical treatment.

Even though back pain is rarely serious, when it does occur, it is important to be aware of "red flags" - signs that you need to contact a doctor. Most of the time you don't need to see a doctor for back pain because it usually goes away with or without treatment. However, you should contact your doctor if you have:

Numbness or tingling.

Your pain is severe and doesn't improve with medication and rest.

You have pain after a fall or an injury.

You have pain along with any of the following problems: trouble urinating; weakness, pain, or numbness in your legs; fever; or unintentional weight loss. Such symptoms could signal a serious problem that requires treatment soon.

Your doctor will tell you if a visit is necessary or if you can treat the pain yourself. The primary role of your doctor is to provide reassurance and rule out the possibility that your back pain is due to a more serious condition.

There are many structures in the back. Many of them have the potential to trigger pain. Doctors have a lot of different words they use to describe back pain, but the real cause of most back pain can't be pinpointed.

We now know that for nearly all back pain x-rays or MRI's can't reveal the root of the problem. In fact, these imaging techniques as a whole have not been helpful and do not lead to more effective reduction of pain. Recently, back pain experts have even said that using these techniques can actually prolong disability because they often lead to unnecessary treatments.

Since nearly all back pain that we experience will go away on its own,

experts recommend using over-the-counter pain medication (following manufacturer instructions and warnings) to reduce the pain and staying as active as pain permits.

Staying in bed can actually make the pain last longer and so should be avoided.

We know that genetics plays a big role in back pain happening. We also know that workers who do heavier handling tasks have more back pain.

Staying in good shape helps to prevent back pain and to recover quicker when you have it. We can't do anything about our genetics, but we can work on staying in shape. We can also minimize the stress on our backs.

LIFTING

One way we put high stress on our backs, often without even realizing it, is by lifting heavy objects incorrectly. Lifting is one the most common physical tasks on the job

and is associated with about 50% of all overexertion back injuries reported on the job. Lifting is also a very common task off the job.

We lift groceries out of the shopping cart. We lift them out of the trunk of our car.

We carry things.

We lift a laundry basket from the floor.

If you have young children in your home, you are lifting them constantly. Even these normal things we do can put a lot of stress on our backs. These stresses can contribute to pain and injury. We can't avoid these tasks, but we can make choices that will be consistent with the right way to lift.

The discs in your back are the flexible “cushions” between the bones of the back. High forces can damage these discs. Forces on these discs can be thousands of pounds for tasks that we might not suspect would be that stressful.

For example, lifting a 40-pound child into a car seat at arms length can put over 2,000 pounds of force on the discs in your lower back! Our discs are tough, but forces over 750 pounds are considered high risk. Forces this high can cause damage to the disc.

Even without lifting an object, bending forward causes high forces on the back. This is because your own body weight creates the stress.

You work hard at your job. Part of the work you do requires lifting. When you lift the wrong way, you can hurt your back. The way in which you lift can make a big difference on the forces on your back.

Twisting, while bending to lift a heavy load, is known to result in a higher rate of injuries and damage to the discs.

Also, the distance from your body to the object lifted has a big impact on the forces on your back. The farther away, the higher the forces.

Planning your lift of any item is very important. Planning only takes a very little time but should be done thoughtfully. Unless you take this little bit of time to plan a lift, you will not do what is needed to reduce your risk of injury due to lifting.

- When lifting anything, you should first decide if it is something you can lift safely. You should consider the weight, bulkiness and stability of the load you are going to lift. If it is too heavy, bulky, or unstable you should not lift it.
- It may be that there is another way to move the load or that someone could help you move it. At work, contact your supervisor or another employee for help; at home, ask a friend, family member, or neighbor. You should also check for tags or labels on loads that indicate a heavy weight
- or require two-person handling. If present, these types of labels are usually in plain sight. Sometimes only the weight is given. Other times it will say, “two-person lift.”
- If the load is not labeled with its weight, you should test it before lifting. To see if you can lift it comfortably, tip the load on its side.
- Before lifting, always test the load for stability. Testing for stability entails determining if there are any parts that could fall out or off of the load during lifting. You also need to look for uneven distribution of weight due to shape or contents of the load.
- When dealing with loads that are unstable and/or too heavy, remember to find out if there is equipment available to help move the load. If the load is not packaged well, you may need to repack it to increase stability.
- Lift only as much as you can safely handle by yourself. You may think that taking more means getting the job done quicker. But the time it takes you to recover from an injury is never worth the risk.

- Get help if the load is too big or bulky for one person. Using a partner to carry an item will allow you to share the load but be careful of having to walk backward or sideways when using a two-person lift. If possible, try to find a co-worker of similar height to help with the lift. When you lift as a team, discuss your plan to make the lift so that there are no surprise movements that could put you or your lifting partners at risk of injury.
- Wear appropriate shoes to avoid slips, trips, or falls. For your own safety it is essential to plan ahead and use shoes that fit your work environment to prevent slips, trips, and falls.
- If you wear gloves, choose the size that fits properly. Depending on the material the gloves are made of and the number of pairs worn at once, more force may be needed to grasp and hold objects. For example, wearing a single pair of gloves can reduce your grip strength up to 40 percent. Wearing two or more pairs of gloves at once can reduce your grip strength up to 60 percent.
- Check for nails, splinters, rough strapping and sharp edges. Injuries can occur from contact with anything sharp on the load being lifted. Take a few seconds to look for these hazards.
- Never carry a load that blocks your vision. Not being able to see where you are going presents a serious hazard to you tripping and falling.
- Stretch and/or warm up before heavy lifting or strenuous activity.
- Avoid lifting from the floor whenever possible. If you must lift from the floor, do not bend at the waist.
- When lifting:
    - Make sure your footing is solid.
    - Center your body over your feet.
    - Get a secure grip. Grip the object with your entire hand, rather than just your fingers. If the object you are lifting has hand holds, use them. Hand holds reduce the effort put into controlling the load. They also reduce the bending needed to lift objects from the ground.
    - Use both hands whenever possible. One-hand lifts not only are harder on your lifting arm, but they actually increase the stress on your back.
    - Keep the lifts in your power zone (i.e., above the knees, below the shoulders, and close to the body), if possible. The best level to lift an object is between your knees and your shoulders.
    - Use slow and smooth movements. Do not use hurried or jerky movements.
    - Keep your back straight, with no curving or slouching. Keep your back straight and tighten your stomach muscles.
    - Keep the load as close to the body as possible. Do not reach out to lift or raise the object above your head. Draw the object close to you, holding your elbows close to your body to keep the load and your body weight centered.

- Lift by pushing up with your legs. Let your legs do the work. Bend at the knees. To the extent possible use your legs to push up and lift the load, not the upper body or back.
- Keep your body facing the object while you lift it. Do not twist your back. Move your feet to turn. Do not twist your body. Step to one side or the other to turn. Point your feet in the direction you want to move. This will prevent you from twisting your body. Twisting the back while lifting and bending forward puts major stress on the back. Twisting while bending forward not only increases the compressive forces on the low back, it also creates twisting stresses that can overstretch ligaments. When this occurs, the spine becomes less stable and the chances of a disc being damaged increases.
- Set the load down by squatting while maintaining the natural curve of your spine.
- Alternate heavy lifting or forceful exertion tasks with less physically demanding tasks.
- Take rest breaks. This give your back the time it needs to recover from heavy lifting.

Take care of your back and yourself! Spend a few minutes each day before work on warm-ups. Exercise regularly to keep your back strong and healthy and ready for any lifting task that might come your way.

Remember also to eat healthy,

drink plenty of water to avoid dehydration, and get plenty of sleep. And do your best to manage your weight.

Remember, a strong, healthy, powerful back is vital to your job. It also helps you enjoy life. Make it a full-time job to take care of your back!

BENDING CONTROL

One way we put high stress on our backs, often without even realizing it, is by bending soon after we get out of bed in the morning.

When you first get up the stress on your back is four times higher than later in the day. The reason for this is that fluids soak into the discs in your back while you sleep. (The discs are the flexible “cushions” between the bones of the back.) These increased fluids, which are mostly water, increase the pressure in your discs when you get up from sleep. The fluids get squeezed out of the discs during the day,

but at night, when there is much less pressure on the discs, these fluids go back into the discs.

The normal things you do when you wake up involve a lot of bending. This puts stress on the disc.

This means it’s easier to damage the discs when you first wake up because of the increased pressure from the extra fluid. Damage to the disc can allow more fluid out of the disc. The reason this is bad is that we know that this fluid causes pain when it reaches nerve endings. As long as the fluid is inside the disc, where there are no nerve endings, you don't have pain.

But if the fluid escapes through cracks, pain can occur. There can be a delay between when you damage the discs and when you first experience the pain. This is why you might not realize it's the early morning bending that is contributing to or prolonging your back pain. Some researchers believe it is this fluid, reaching our nerve endings that is the real source of most back pain.

In fact, this fluid may be responsible for back pain symptoms once thought to be related to pressure on nerves. The fluid can make nerves so sensitive to sending out pain signals that only a slight movement triggers extreme pain.

Research has shown that limiting early morning bending can significantly reduce pain for people with recurring back pain. Even if you don't have back pain, preventing damage to the disc when it's most vulnerable, right after getting out of bed, can help reduce the chances of back pain. Here's how you can reduce the stress on your back when you first get out of bed.

The first two hours after getting out of bed are the most critical and **even *partial* compliance during this time is better than no compliance.**. This is when the back is most vulnerable. During the first two hours, there should be:

- **NO BENDING**
- **NO SQUATTING**
- **NO SITTING (Sitting is more stressful to the back than standing)**
- **NO TWISTING**
- **NO LIFTING OVER 10 POUNDS**
- **STANDING AND WALKING ARE O.K.**

Don't do any stretching

or exercise till later in your day.

Plan ahead. It may be necessary to get up a little earlier to allow yourself more "no-bending" time. Today when you go home, walk through your morning routine and notice all the things you do that require you to bend. Then do some planning:

Make a list of activities that *must* be done in the evening to prevent you from bending in the morning. For example:

- Showering
- Find a high surface that you can comfortably work on after waking.
- Have a firm chair available for putting on shoes and socks (last thing before you leave your home).
- Place TV Remote on high surface.
- Lay out clothes on high dresser.

- Put breakfast foods in places where bending is not required to retrieve them.
- Perform household chores that require bending later in your day.
- Place commonly used toiletries in easily accessible locations

Since the first two hours are the most critical, certain activities require special care:

Before getting out of bed: Avoid stretching. The back muscles are very strong, and can produce large amounts of pressure within the disc.

Getting out of bed: Find the way that works best for you. One way is to get to the edge of the bed on your side, drop your lower legs off the bed and with one smooth motion, keeping your back as straight as possible, push yourself up into a standing position using your arms.

Another way is to roll onto your stomach at the edge of the bed, drop your legs off the bed while simultaneously using your arms to push your upper body up off the bed into a standing position. Choose a way that is easiest for you.

Using the Bathroom: Use a back scratcher to raise the toilet seat. Delay sitting on the toilet until after two hours. If that's not possible, straddle the toilet and sit down, keeping the back as straight as possible. If available, hold onto a wall or stable surface at your side while sitting down and standing up. When standing up, move forward to the edge of the seat. Push up, while holding onto support, with the back as straight as possible.

Shaving: Shaving for men is O.K. as long as you don't bend over the sink. If you find it necessary to lower yourself to the sink, bend your knees. Women should shave their legs before going to bed.

Showering: Shower before going to bed.

Cleaning teeth: Cleaning teeth is O.K. if you don't bend over the sink. Use a cup for rinsing.

Eating: Eating breakfast should be done in a standing position. Use the kitchen counter or the top of a high dresser.

Getting dressed: If possible, wait until two hours have passed before getting dressed. Use slip-on shoes or slippers after getting out of bed.

Before going to bed, place your clothes on top of the dresser to avoid bending over in the morning.

Pants, panties and undershorts: Support yourself against something solid (wall, sink or dresser) with one arm. With the other arm, hold the clothing down, and step into it without bending the back.

Shoes, socks and pantyhose: Delay putting these items on as long as possible. Sit on a firm chair, keeping the back straight, bring one foot up and rest it on the other knee. Maintain a straight back while slipping the socks or pantyhose over the foot. Pantyhose should be pulled up as far as possible before standing up. Shoes can be tied in the same position, or stand and raise the foot on a chair or high surface. Slide to the edge of the chair before standing.

Reading and writing: Use the top of a high dresser to read or write. Be careful not to bend the neck down excessively. The discs in the neck are similar to the discs in the back, and may be just as vulnerable in the early morning.

Television: Watching television must be done in a standing position, using the remote control.
Computer Use Must also be in a standing position. Keyboard/mouse at elbow height, at edge of surface.

Exercising: Other than walking, don't exercise or stretch until later in your day – at least 4 hours after getting out of bed.

Driving and riding: Keep the back as straight as possible when entering, leaving or riding in a vehicle. Minimize twisting when entering a vehicle by turning your back toward the seat (facing away from the vehicle) and then sitting down; then swing your legs into the vehicle while maintaining the alignment between your legs and upper body. Use available hand holds and surfaces to minimize stress on your back. Reverse the procedure for exiting the vehicle. While riding, recline slightly to avoid "crunching up" your legs which bends the lower back.

Items on the floor: If you drop something, don't bend over to pick it up. Pick it up later.

Napping: Nap upright in a comfortable chair. Do not lie down. Lying down results in an accumulation of fluid in the disc, no matter when you lay down.

Here's ways you can Remind yourself To Avoid Early Morning Bending:

- Tell someone who lives with you what you are doing, and ask them to give you reminders.
- Put books or papers on chairs,
- or flip sofa cushions up to remind you not to sit after waking.
- Consider keeping a log or graph (plot) of how many minutes after getting out of bed you were able to stand without bending each day, setting goals and rewarding yourself for meeting/exceeding your goals.

Finally, remember that this is a change in your daily routine and it may take some time to get used to. So don't become discouraged if you forget a couple of things at the beginning. Controlling early morning bending may seem inconvenient at first but will become routine quickly and will reward you by helping you reduce your chances of back pain and help you get better quicker when you do have back pain.

24 APPENDIX XI – REMINDER CARDS CONTENT

(On Next Page)

Lifting Reminder Card:

- Lifting can put 1,000's of lbs. of stress on your back
- Lift carefully
- Plan your lift:
  - Lift only what you can handle
  - Use team lifting
  - Don't bend at the waist

Keep the load close to your body

Bending Reminder Card:

- Stress on your back is 4X higher after sleep
- Get out of bed carefully
- Don't bend or sit the 1st two hours after getting up:
  - Standing or walking are OK
  - No stretching or exercise till later in day
  - Plan ahead the night before

Give yourself reminders

Front of both cards:

25 APPENDIX XII – DETAILED ANALYSIS RESULTS OF MIXED EFFECTS ANALYSES AND PREDICTED VALUES BY SURVEY AND INTERVENTION GROUP

(On Next Page)

Notes:

1. **Likelihood ratio (LR) tests on each of the following analyses (Mixed Effects Logistic Regression, Mixed Effects Ordered Logistic Regression, and Mixed Effects Negative Binomial Regression) resulted in statistical significance below p=0.05, indicating the chosen analyses were appropriate.**

2. **The data for the variable "survey" was omitted for the second year data point (=2) because of collinearity.**

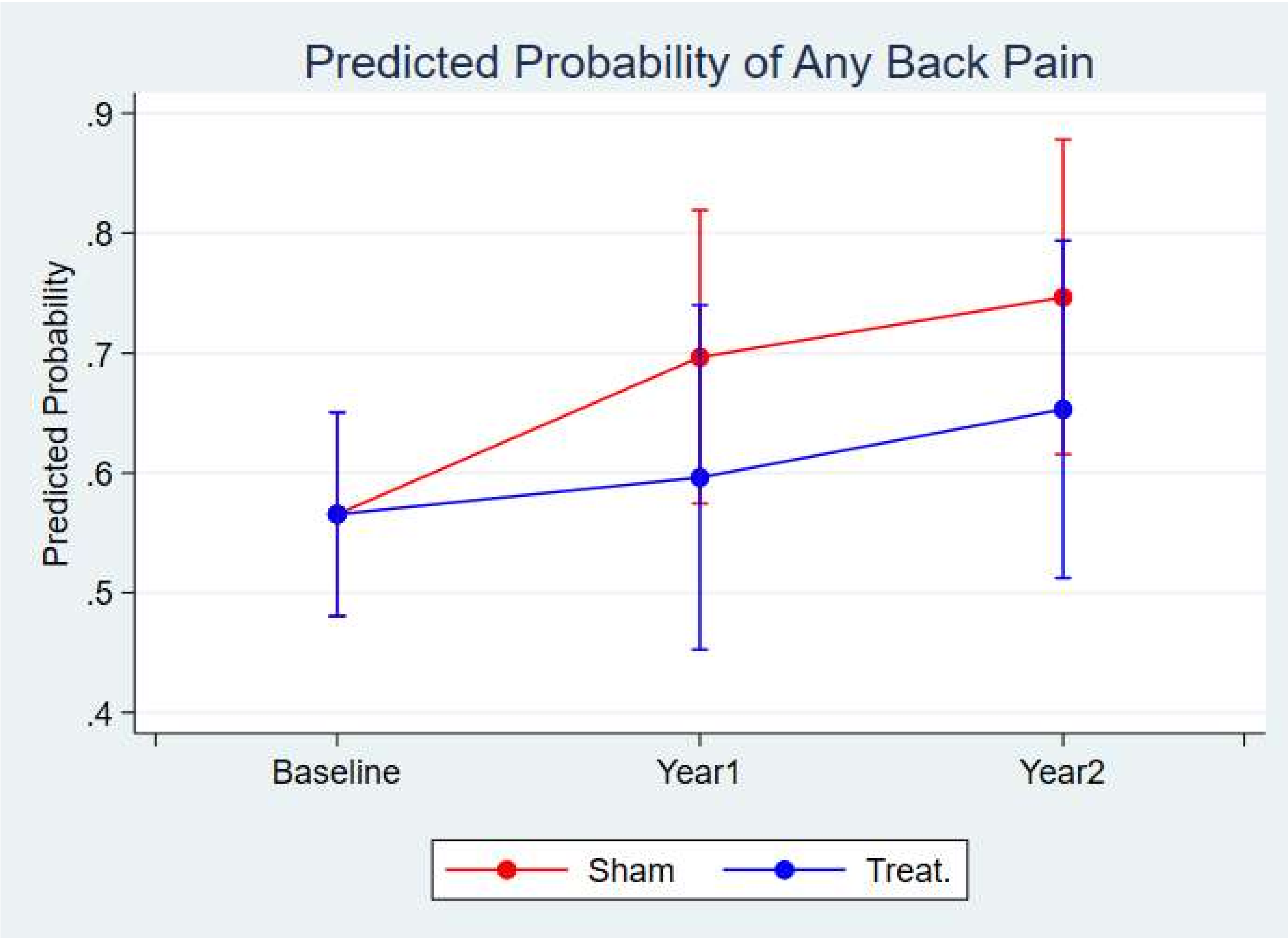
Any Back Pain

Table 25-1. Mixed Effects Logistic Regression for Any Back Pain

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Any Back Pain					
Sex=Female	0.425	0.226	-1.61	0.107	[0.150,1.203]
Age (Centered)	0.975	0.027	-0.92	0.357	[0.924,1.029]
Number of lifts over 25 pounds/day	1.028	0.029	0.98	0.328	[0.973,1.087]
Tenure	1.019	0.037	0.52	0.600	[0.949,1.095]
Shift=Night	1.652	0.929	0.89	0.372	[0.548,4.974]
Sleep Time (hrs) on Average per 24hrs	0.752	0.114	-1.88	0.060	[0.559,1.012]
Language (English or Spanish)=Spanish	1.333	0.701	0.55	0.585	[0.475,3.738]
Have More than UCLA Job=Yes	0.302	0.235	-1.54	0.124	[0.066,1.386]
Stress level during past week=Some	4.174	2.146	2.78	0.005	[1.524,11.433]
Stress level during past week=Most	5.032	4.246	1.91	0.056	[0.963,26.304]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	2.855	1.634	1.83	0.067	[0.930,8.763]
Treatment Training (Bending)	1.365	0.385	1.10	0.271	[0.785,2.373]
Survey=Year1	0.907	0.424	-0.21	0.835	[0.363,2.266]
Survey=Year2	1.000	0.000			
Intercept	5.084	6.190	1.34	0.182	[0.468,55.279]
/					
var(_cons[idnum])	3.210	1.875			[1.022,10.083]

Table 25-2. Marginal Predicted Probability of Any Back Pain

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.5654022	.0433773	13.03	0.000	.4803843	.6504201
Sham@Year1	.696728	.0624431	11.16	0.000	.5743418	.8191143
Sham@Year2	.7467821	.067014	11.14	0.000	.6154371	.8781272
Treat.@Baseline	.5654022	.0433773	13.03	0.000	.4803843	.6504201
Treat.@Year1	.596174	.0734357	8.12	0.000	.4522426	.7401053
Treat.@Year2	.6530917	.0718677	9.09	0.000	.5122336	.7939498


Predicted Probability of Any Back Pain
Predicted Probability
.9
.8
.7
.6
.5
.4
Baseline
Year1
Year2
Sham
Treat.

1. Both the sham (lifting) and treatment (bending) training increased the odds of any back pain (odds ratio, p, & [CI's]: 2.855, 0.067, [0.93,8.763] and 1.365, 0.271, [0.785,2.373], sham and treatment training respectively). This represents 186% increased odds of reporting any back pain for sham subjects receiving the sham (lifting) training and 37% increased odds of reporting any back pain for the treatment training (bending) over the course of the study.
2. The predicted probability of reporting any back pain was 0.57 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting any back pain one year after the sham training was 0.70 (23% higher than baseline).
4. The predicted probability of sham subjects reporting any back pain two years after the sham training and one year after the treatment training was 0.75 (32% higher than baseline and 7% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting any back pain one year after the treatment training was 0.60 (5% higher than baseline).
6. The predicted probability of treatment subjects reporting any back pain two years after the first treatment training and one year after the second treatment training was 0.75 (32% higher than baseline and 7% higher than one year after the second treatment training).

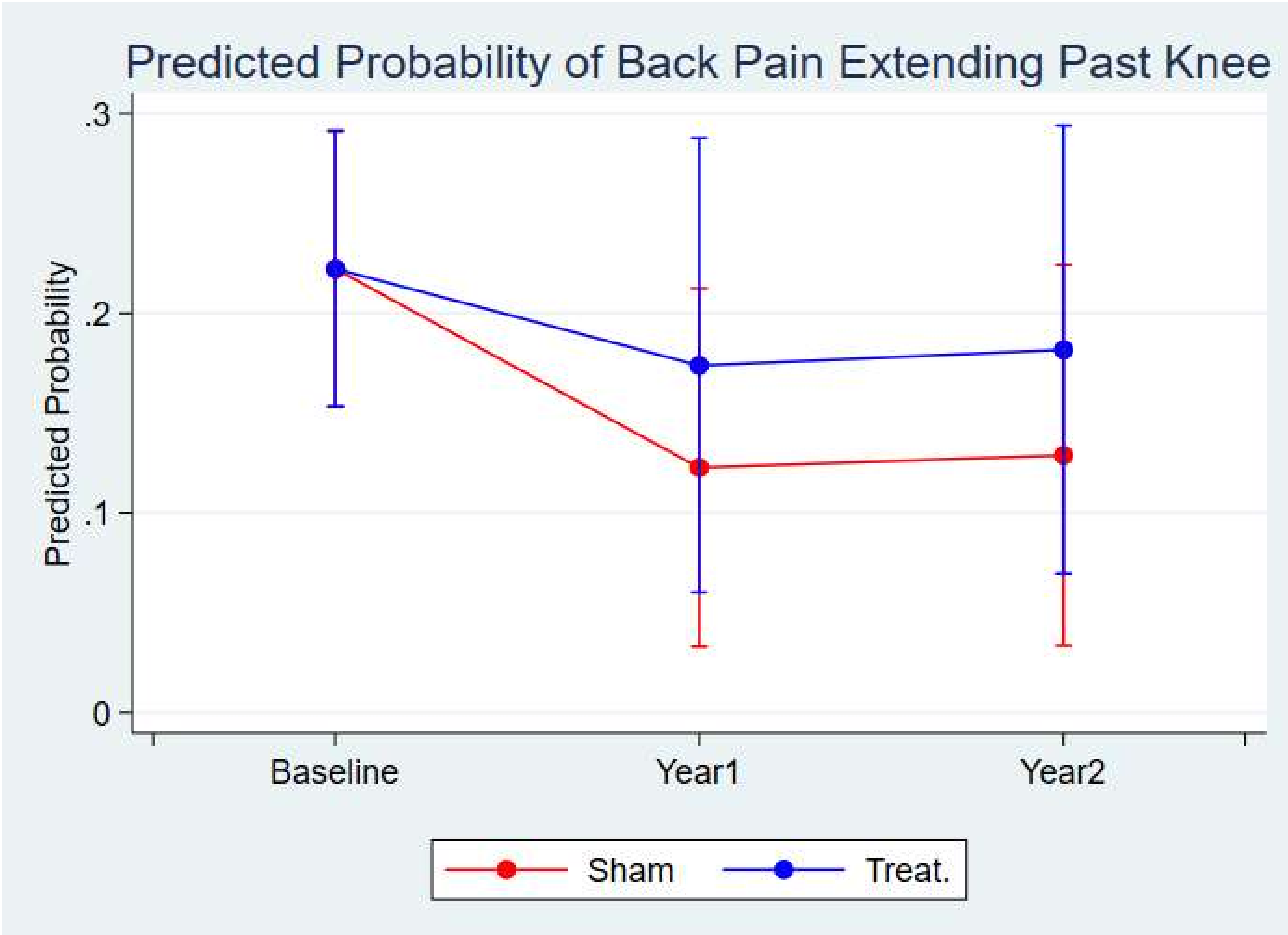
Back Pain Extending Past the Knee

Table 25-3. Mixed Effects Logistic Regression for Back Pain Extending Past the Knee

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Back Pain past the knee (Sciatica)					
Sex=Female	0.642	0.384	-0.74	0.459	[0.198,2.076]
Age (Centered)	1.036	0.031	1.15	0.249	[0.976,1.099]
Number of lifts over 25 pounds/day	1.079	0.032	2.59	0.010	[1.019,1.144]
Tenure	0.938	0.040	-1.49	0.135	[0.863,1.020]
Shift=Night	3.631	2.669	1.75	0.079	[0.860,15.336]
Sleep Time (hrs) on Average per 24hrs	0.679	0.132	-2.00	0.046	[0.464,0.993]
Language (English or Spanish)=Spanish	1.306	0.844	0.41	0.679	[0.368,4.633]
Have More than UCLA Job=Yes	0.012	0.022	-2.37	0.018	[0.000,0.464]
Stress level during past week=Some	4.477	2.616	2.56	0.010	[1.424,14.073]
Stress level during past week=Most	3.309	2.923	1.35	0.175	[0.586,18.691]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.433	0.296	-1.22	0.221	[0.113,1.656]
Treatment Training (Bending)	0.815	0.273	-0.61	0.542	[0.423,1.570]
Survey=Year1	0.749	0.444	-0.49	0.626	[0.234,2.395]
Survey=Year2	1.000	0.000			
Intercept	0.361	0.534	-0.69	0.491	[0.020,6.555]
/					
var(_cons[idnum])	2.544	1.785			[0.643,10.064]

Table 25-4. Marginal Predicted Probability of Back Pain Extending Past the Knee

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.2222561	.0351571	6.32	0.000	.1533494	.2911627
Sham@Year1	.1225529	.0458423	2.67	0.008	.0327036	.2124023
Sham@Year2	.1287534	.0487105	2.64	0.008	.0332825	.2242243
Treat.@Baseline	.2222561	.0351571	6.32	0.000	.1533494	.2911627
Treat.@Year1	.1738214	.0580736	2.99	0.003	.0599992	.2876437
Treat.@Year2	.1816825	.0572635	3.17	0.002	.069448	.2939169



1. Both the sham (lifting) and treatment (bending) training decreased the odds of sciatica (odds ratio, p, & [CI's]: 0.433, 0.221, [0.113,1.656] and 0.815, 0.542, [0.423,1.57], sham and treatment training respectively). This represents 57% decreased odds of reporting sciatica for sham subjects receiving the sham (lifting) training and 19% decreased odds of reporting sciatica for the treatment training (bending) over the course of

the study.

2. The predicted probability of reporting sciatica was 0.22 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting sciatica one year after the sham training was 0.12 (45% lower than baseline).

4. The predicted probability of sham subjects reporting sciatica two years after the sham training and one year after the treatment training was 0.13 (42% lower than baseline and 5% higher than one year after the sham training).

5. The predicted probability of treatment subjects reporting sciatica one year after the treatment training was 0.17 (22% lower than baseline).

6. The predicted probability of treatment subjects reporting sciatica two years after the first treatment training and one year after the second treatment training was 0.13 (42% lower than baseline and 5% higher than one year after the second treatment training).

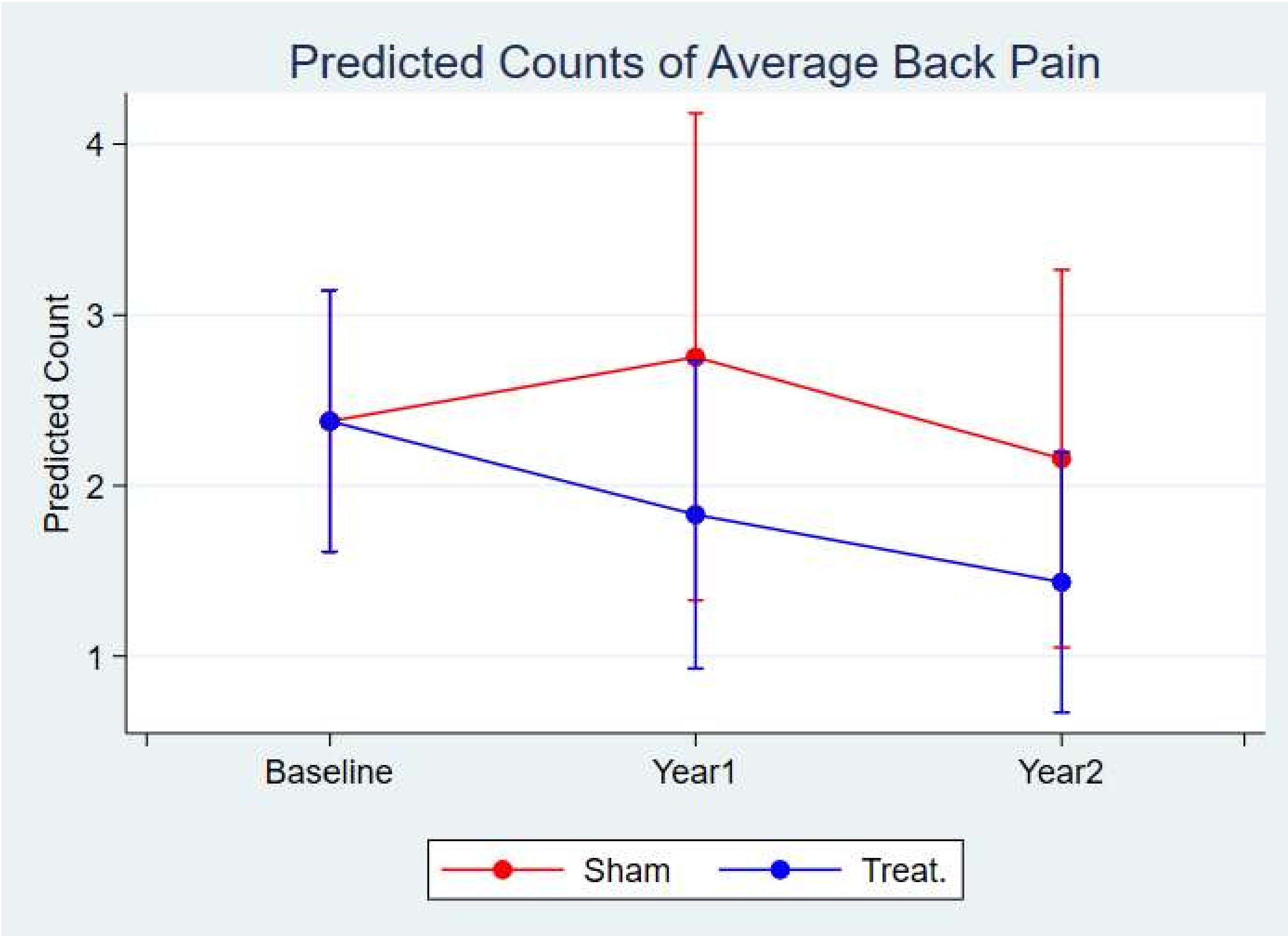
Average Back Pain

Table 25-5. Mixed Effects Negative Binomial Regression for Average Back Pain

	Mixed Effects Negative Binomial Regression				
	IRR	Std. error	z	p-value	95% CI
Average Back Pain Level (NRS Pain 0-10)					
Sex=Female	0.594	0.140	-2.21	0.027	[0.374,0.943]
Age (Centered)	1.003	0.013	0.22	0.824	[0.977,1.030]
Number of lifts over 25 pounds/day	1.006	0.013	0.48	0.630	[0.982,1.031]
Tenure	0.985	0.016	-0.96	0.335	[0.955,1.016]
Shift=Night	1.580	0.411	1.76	0.079	[0.949,2.631]
Sleep Time (hrs) on Average per 24hrs	0.911	0.062	-1.37	0.171	[0.797,1.041]
Language (English or Spanish)=Spanish	0.827	0.217	-0.73	0.468	[0.494,1.382]
Have More than UCLA Job=Yes	0.928	0.313	-0.22	0.824	[0.478,1.798]
Stress level during past week=Some	2.268	0.537	3.46	0.001	[1.426,3.607]
Stress level during past week=Most	2.783	1.038	2.75	0.006	[1.340,5.781]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	1.169	0.306	0.60	0.552	[0.699,1.953]
Treatment Training (Bending)	0.777	0.123	-1.59	0.112	[0.569,1.060]
Survey=Year1	0.991	0.246	-0.04	0.971	[0.609,1.612]
Survey=Year2	1.000	0.000			
Intercept	2.332	1.249	1.58	0.114	[0.816,6.662]
/					
lnalpha	0.687	0.158			[0.376,0.997]
var(_cons[idnum])	0.000	0.000			

Table 25-6. Marginal Predicted Counts of Average Back Pain

	Predict.Count	Std. error	z	p-value	95% CI	
Sham@Baseline	2.377216	.3910051	6.08	0.000	1.61086	3.143572
Sham@Year1	2.753638	.7278128	3.78	0.000	1.327151	4.180125
Sham@Year2	2.158075	.5650764	3.82	0.000	1.050546	3.265605
Treat.@Baseline	2.377216	.3910051	6.08	0.000	1.61086	3.143572
Treat.@Year1	1.830007	.4605627	3.97	0.000	.9273202	2.732693
Treat.@Year2	1.434209	.3889889	3.69	0.000	.6718044	2.196613



1. The sham (lifting) training increased the percent score of, but the treatment (bending) training decreased the percent score of average back pain (incident rate ratio, p, & [CI's]: 1.169, 0.552, [0.699,1.953] and 0.777, 0.112, [0.569,1.06], sham and treatment training respectively). This represents 17% increased score for average back pain for sham subjects receiving the sham (lifting) training and 22% decreased score for

average back pain for the treatment training (bending) over the course of the study.

2. The predicted score for average back pain was 2.38 at baseline (for both sham and treatment subjects).

3. The predicted score of sham subjects reporting average back pain one year after the sham training was 2.75 (16% higher than baseline).

4. The predicted score of sham subjects reporting average back pain two years after the sham training and one year after the treatment training was 2.16 (9% lower than baseline and 22% lower than one year after the sham training).

5. The predicted score of treatment subjects reporting average back pain one year after the treatment training was 1.83 (23% lower than baseline).

6. The predicted score of treatment subjects reporting average back pain two years after the first treatment training and one year after the second treatment training was 2.16 (9% lower than baseline and 22% lower than one year after the second treatment training).

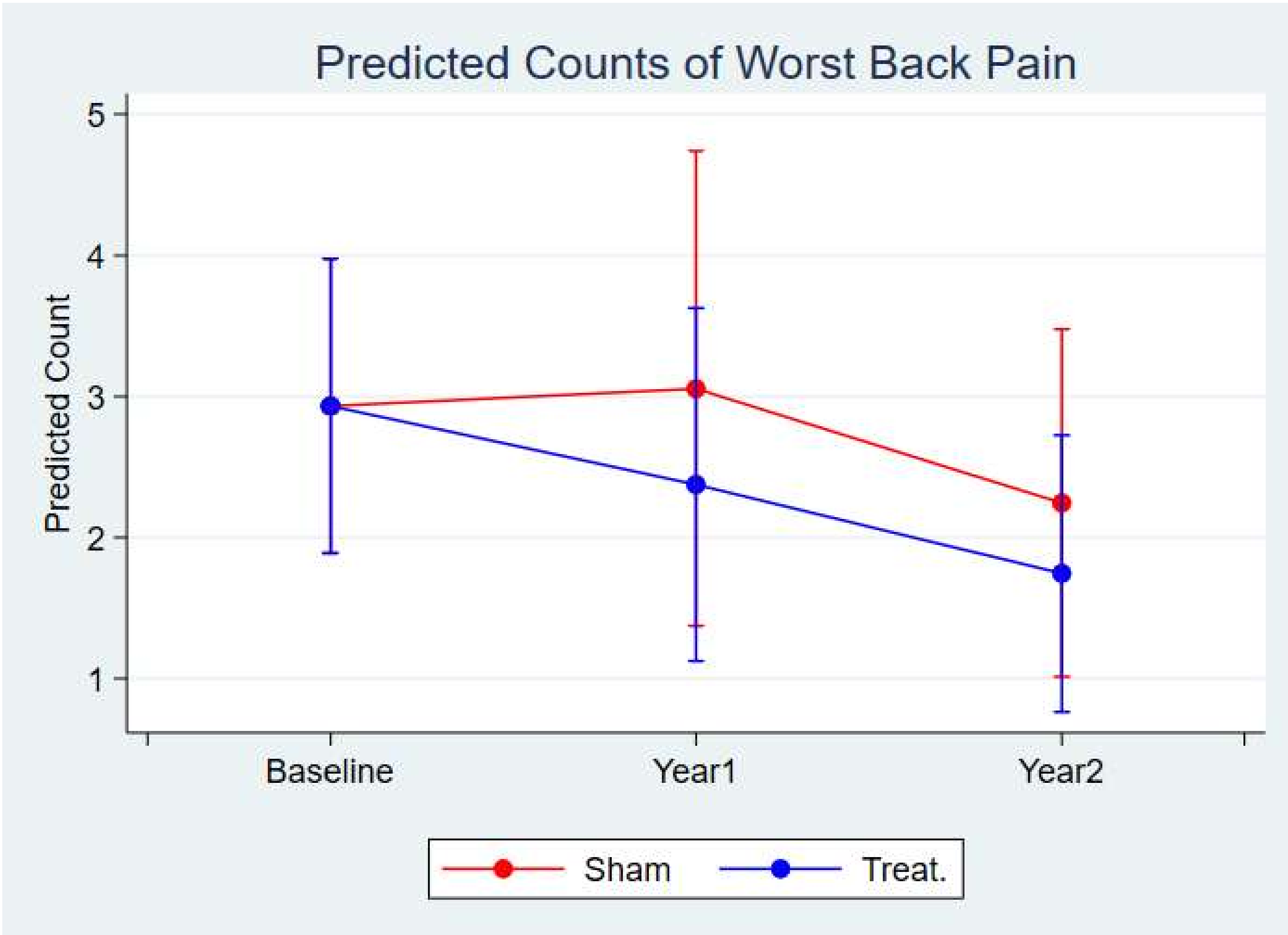
Worst Back Pain

Table 25-7. Mixed Effects Negative Binomial Regression for Worst Back Pain

	Mixed Effects Negative Binomial Regression				
	IRR	Std. error	z	p-value	95% CI
Worst Back Pain Level (NRS Pain 0-10)					
Sex=Female	0.609	0.152	-1.99	0.047	[0.373,0.994]
Age (Centered)	1.004	0.014	0.28	0.777	[0.977,1.032]
Number of lifts over 25 pounds/day	1.006	0.014	0.41	0.678	[0.979,1.033]
Tenure	0.986	0.016	-0.84	0.400	[0.954,1.019]
Shift=Night	1.420	0.391	1.27	0.203	[0.827,2.437]
Sleep Time (hrs) on Average per 24hrs	0.917	0.067	-1.18	0.239	[0.795,1.059]
Language (English or Spanish)=Spanish	0.667	0.185	-1.46	0.145	[0.387,1.149]
Have More than UCLA Job=Yes	0.946	0.340	-0.16	0.876	[0.467,1.913]
Stress level during past week=Some	2.075	0.523	2.90	0.004	[1.266,3.400]
Stress level during past week=Most	3.450	1.313	3.25	0.001	[1.636,7.274]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.992	0.280	-0.03	0.978	[0.571,1.725]
Treatment Training (Bending)	0.771	0.129	-1.55	0.121	[0.556,1.071]
Survey=Year1	1.050	0.276	0.18	0.853	[0.627,1.759]
Survey=Year2	1.000	0.000			
Intercept	3.038	1.733	1.95	0.051	[0.993,9.293]
/					
lnalpha	0.866	0.150			[0.573,1.160]
var(_cons[idnum])	0.000	0.000			

Table 25-8. Marginal Predicted Counts of Worst Back Pain

	Predict.Count	Std. error	z	p-value	95% CI	
Sham@Baseline	2.932691	.5327842	5.50	0.000	1.888453	3.976929
Sham@Year1	3.055164	.8584624	3.56	0.000	1.372608	4.737719
Sham@Year2	2.244891	.6289337	3.57	0.000	1.012204	3.477579
Treat.@Baseline	2.932691	.5327842	5.50	0.000	1.888453	3.976929
Treat.@Year1	2.375189	.6388668	3.72	0.000	1.123033	3.627345
Treat.@Year2	1.745256	.4999926	3.49	0.000	.7652882	2.725223



1. Both the sham (lifting) and treatment (bending) training decreased the percent score of worst back pain (incident rate ratio, p, & [CI's]: 0.992, 0.978, [0.571,1.725] and 0.771, 0.121, [0.556,1.071], sham and treatment training respectively). This represents 1% decreased score for worst back pain for sham subjects receiving the sham (lifting) training and 23% decreased score for worst back pain for the treatment training

(bending) over the course of the study.

2. The predicted score for worst back pain was 2.93 at baseline (for both sham and treatment subjects).

3. The predicted score of sham subjects reporting worst back pain one year after the sham training was 3.06 (4% higher than baseline).

4. The predicted score of sham subjects reporting worst back pain two years after the sham training and one year after the treatment training was 2.24 (23% lower than baseline and 27% lower than one year after the sham training).

5. The predicted score of treatment subjects reporting worst back pain one year after the treatment training was 2.38 (19% lower than baseline).

6. The predicted score of treatment subjects reporting worst back pain two years after the first treatment training and one year after the second treatment training was 2.24 (23% lower than baseline and 27% lower than one year after the second treatment training).

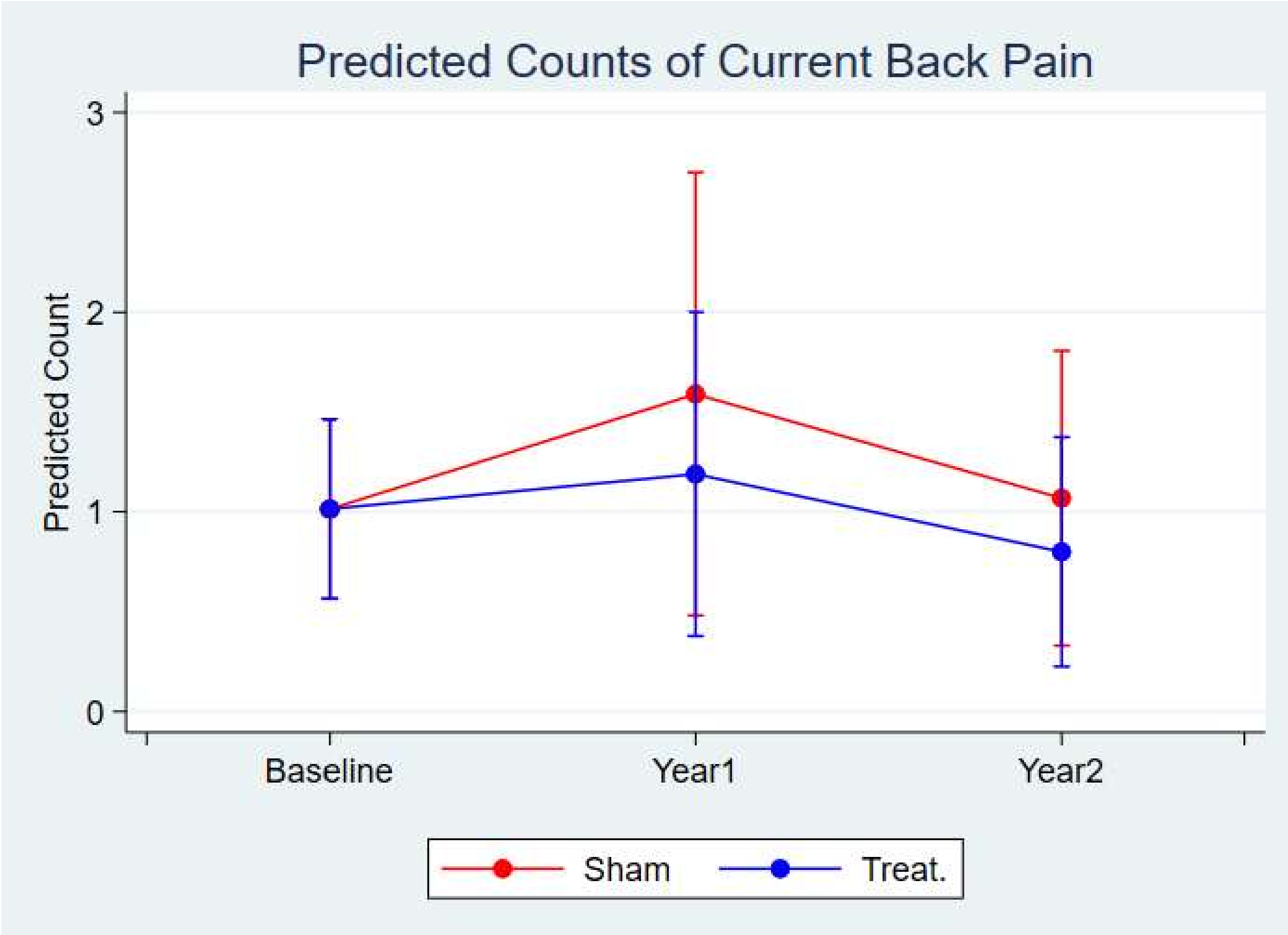
Current Back Pain

Table 25-9. Mixed Effects Negative Binomial Regression for Current Back Pain

	Mixed Effects Negative Binomial Regression				
	IRR	Std. error	z	p-value	95% CI
Current Back Pain Level (NRS Pain 0-10)					
Sex=Female	0.481	0.159	-2.22	0.027	[0.252,0.919]
Age (Centered)	1.002	0.018	0.11	0.915	[0.968,1.037]
Number of lifts over 25 pounds/day	0.995	0.017	-0.27	0.784	[0.963,1.029]
Tenure	1.013	0.023	0.60	0.549	[0.970,1.059]
Shift=Night	2.181	0.808	2.10	0.035	[1.055,4.509]
Sleep Time (hrs) on Average per 24hrs	0.930	0.090	-0.75	0.451	[0.770,1.123]
Language (English or Spanish)=Spanish	1.472	0.515	1.10	0.269	[0.741,2.924]
Have More than UCLA Job=Yes	1.321	0.621	0.59	0.554	[0.525,3.320]
Stress level during past week=Some	3.621	1.221	3.82	0.000	[1.870,7.011]
Stress level during past week=Most	3.708	1.938	2.51	0.012	[1.331,10.326]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	1.187	0.416	0.49	0.625	[0.597,2.360]
Treatment Training (Bending)	0.888	0.190	-0.56	0.579	[0.583,1.352]
Survey=Year1	1.321	0.445	0.83	0.409	[0.682,2.558]
Survey=Year2	1.000	0.000			
Intercept	0.489	0.380	-0.92	0.357	[0.107,2.240]
/					
lnalpha	1.222	0.190			[0.848,1.595]
var(_cons[idnum])	0.000	0.000			

Table 25-10. Marginal Predicted Counts of Current Back Pain

	Predict.Count	Std. error	z	p-value	95% CI	
Sham@Baseline	1.013612	.2293515	4.42	0.000	.5640913	1.463133
Sham@Year1	1.589664	.5663242	2.81	0.005	.4796894	2.699639
Sham@Year2	1.067905	.3771212	2.83	0.005	.3287611	1.807049
Treat.@Baseline	1.013612	.2293515	4.42	0.000	.5640913	1.463133
Treat.@Year1	1.188736	.4145505	2.87	0.004	.376232	2.00124
Treat.@Year2	.7985693	.2935711	2.72	0.007	.2231806	1.373958



1. The sham (lifting) training increased the percent score of, but the treatment (bending) training decreased the percent score of current back pain (incident rate ratio, p, & [CI's]: 1.187, 0.625, [0.597,2.36] and 0.888, 0.579, [0.583,1.352], sham and treatment training respectively). This represents 19% increased score for current back pain for sham subjects receiving the sham (lifting) training and 11% decreased score for current

back pain for the treatment training (bending) over the course of the study.

2. The predicted score for current back pain was 1.01 at baseline (for both sham and treatment subjects).

3. The predicted score of sham subjects reporting current back pain one year after the sham training was 1.59 (57% higher than baseline).

4. The predicted score of sham subjects reporting current back pain two years after the sham training and one year after the treatment training was 1.07 (5% higher than baseline and 33% lower than one year after the sham training).

5. The predicted score of treatment subjects reporting current back pain one year after the treatment training was 1.19 (17% higher than baseline).

6. The predicted score of treatment subjects reporting current back pain two years after the first treatment training and one year after the second treatment training was 1.07 (5% higher than baseline and 33% lower than one year after the second treatment training).

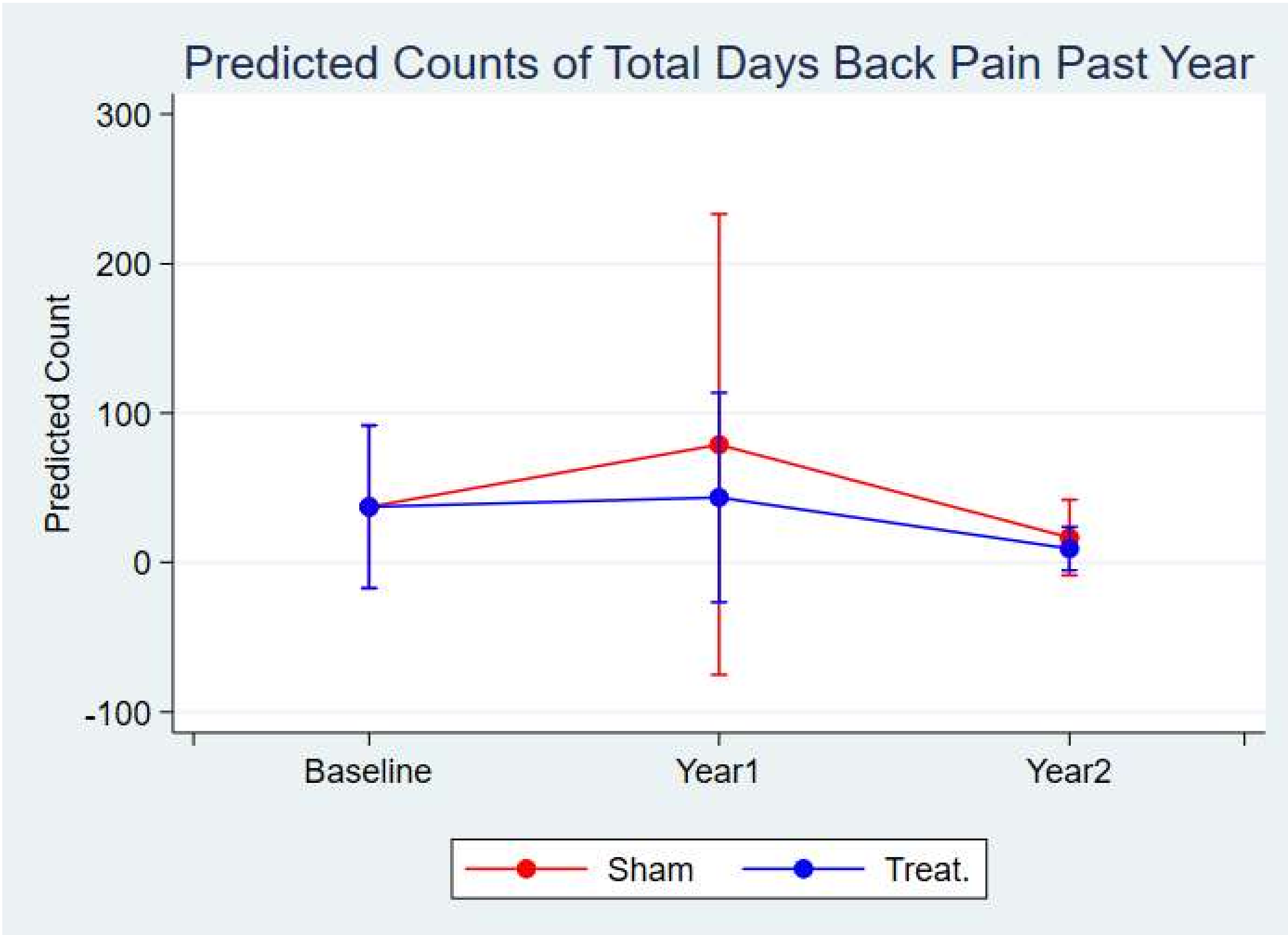
Total Days with Back Pain During Past Year

Table 25-11. Mixed Effects Negative Binomial Regression for Total Days with Back Pain During Past Year

	Mixed Effects Negative Binomial Regression				
	IRR	Std. error	z	p-value	95% CI
tde					
Sex=Female	1.023	0.520	0.04	0.965	[0.377,2.771]
Age (Centered)	1.091	0.030	3.12	0.002	[1.033,1.152]
Number of lifts over 25 pounds/day	1.021	0.037	0.59	0.556	[0.952,1.096]
Tenure	0.949	0.033	-1.51	0.131	[0.887,1.016]
Shift=Night	1.543	0.838	0.80	0.425	[0.532,4.473]
Sleep Time (hrs) on Average per 24hrs	0.758	0.129	-1.63	0.102	[0.543,1.057]
Language (English or Spanish)=Spanish	0.479	0.279	-1.26	0.207	[0.152,1.502]
Have More than UCLA Job=Yes	4.140	2.904	2.03	0.043	[1.047,16.368]
Stress level during past week=Some	2.629	1.441	1.76	0.078	[0.898,7.698]
Stress level during past week=Most	9.169	7.400	2.75	0.006	[1.885,44.599]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.900	0.527	-0.18	0.857	[0.286,2.833]
Treatment Training (Bending)	0.496	0.209	-1.67	0.096	[0.217,1.132]
Survey=Year1	2.357	1.287	1.57	0.117	[0.808,6.875]
Survey=Year2	1.000	0.000			
Intercept	34.910	46.803	2.65	0.008	[2.522,483.201]
/					
lnalpha	2.086	0.127			[1.837,2.334]
var(_cons[idnum])	0.000	0.000			

Table 25-12. Marginal Predicted Counts of Total Days with Back Pain During Past Year

	Predict.Count	Std. error	z	p-value	95% CI	
Sham@Baseline	37.16061	27.83489	1.34	0.182	-17.39477	91.71599
Sham@Year1	78.84316	78.65485	1.00	0.316	-75.31752	233.0038
Sham@Year2	16.5982	12.92205	1.28	0.199	-8.728559	41.92495
Treat.@Baseline	37.16061	27.83489	1.34	0.182	-17.39477	91.71599
Treat.@Year1	43.45315	35.80775	1.21	0.225	-26.72875	113.6351
Treat.@Year2	9.147832	7.423762	1.23	0.218	-5.402473	23.69814



1. Both the sham (lifting) and treatment (bending) training decreased the percent score of total days of back pain (incident rate ratio, p, & [CI's]: 0.9, 0.857, [0.286,2.833] and 0.496, 0.096, [0.217,1.132], sham and treatment training respectively). This represents 10% decreased count of total days of back pain for sham subjects receiving the sham (lifting) training and 50% decreased count of total days of back pain for the

treatment training (bending) over the course of the study.

2. The predicted count for total days of back pain was 37.16 at baseline (for both sham and treatment subjects).

3. The predicted count of total days of back pain by sham subjects one year after the sham training was 78.84 (112% higher than baseline).

4. The predicted count of total days of back pain by sham subjects two years after the sham training and one year after the treatment training was 16.6 (55% lower than baseline and 79% lower than one year after the sham training).

5. The predicted count of total days of back pain by treatment subjects one year after the treatment training was 43.45 (17% higher than baseline).

6. The predicted count of total days of back pain reported by treatment subjects two years after the first treatment training and one year after the second treatment training was 16.6 (55% lower than baseline and 79% lower than one year after the second treatment training).

Longest Episode of Back Pain (None, <6 Weeks, 6-12 Weeks, ≥12 Weeks)

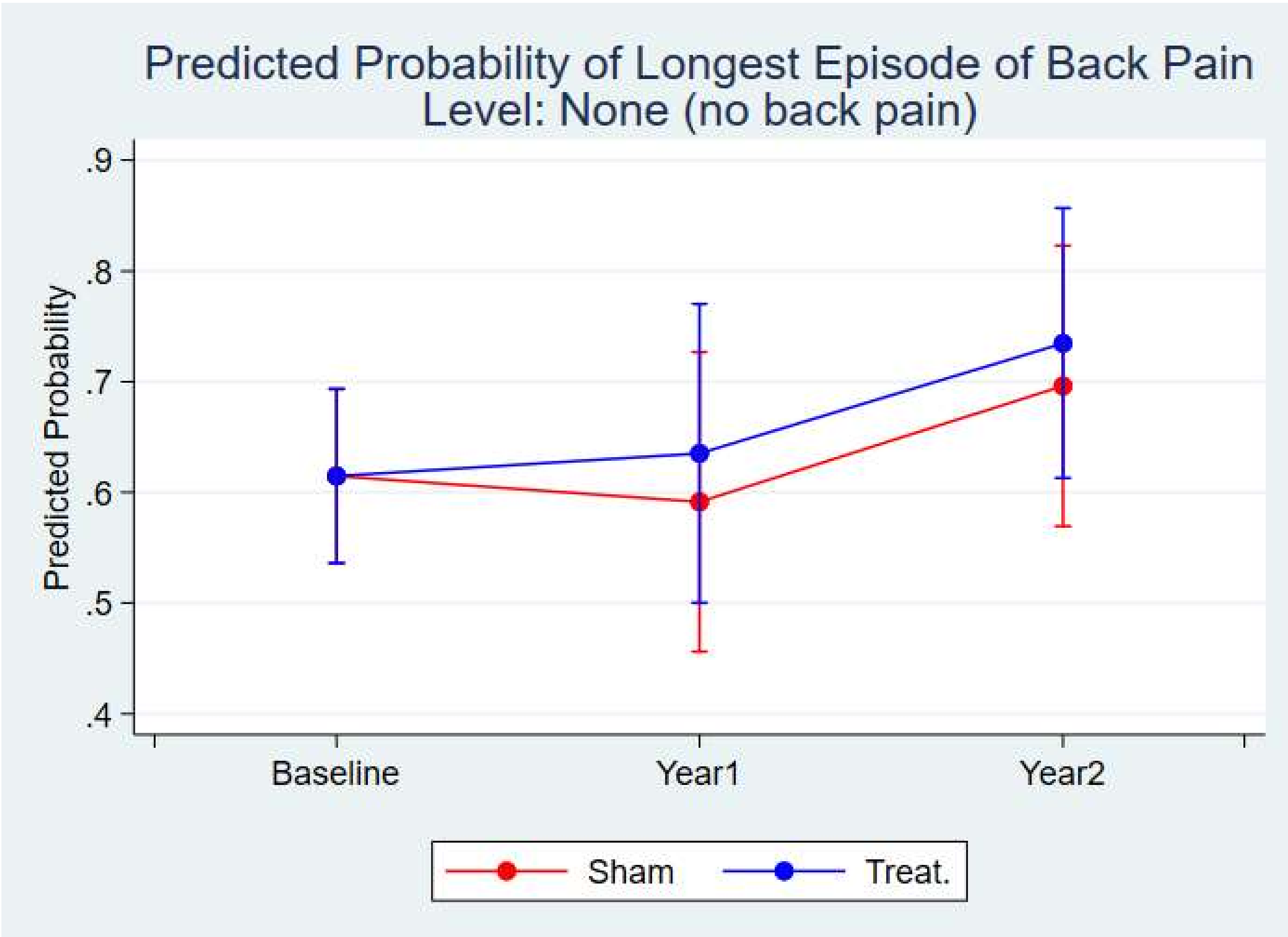
Table 25-13. Mixed Effects Ordered Logistic Regression for Longest Episode of Back Pain (None, <6 Weeks, 6-12 Weeks, ≥12 Weeks)

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Longest Episode of Back Pain					
Sex=Female	0.465	0.194	-1.84	0.066	[0.205,1.053]
Age (Centered)	1.010	0.022	0.47	0.638	[0.969,1.053]
Number of lifts over 25 pounds/day	1.012	0.019	0.62	0.533	[0.975,1.050]
Tenure	0.980	0.028	-0.72	0.472	[0.927,1.036]
Shift=Night	2.347	1.125	1.78	0.075	[0.918,6.003]
Sleep Time (hrs) on Average per 24hrs	0.784	0.093	-2.04	0.041	[0.621,0.990]
Language (English or Spanish)=Spanish	0.624	0.296	-0.99	0.321	[0.246,1.583]
Have More than UCLA Job=Yes	1.037	0.583	0.06	0.948	[0.345,3.122]
Stress level during past week=Some	4.132	1.685	3.48	0.001	[1.858,9.188]
Stress level during past week=Most	5.674	3.337	2.95	0.003	[1.792,17.968]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.881	0.389	-0.29	0.774	[0.371,2.095]
Treatment Training (Bending)	0.673	0.166	-1.61	0.108	[0.416,1.091]
Survey=Year1	1.308	0.516	0.68	0.496	[0.604,2.834]
Survey=Year2	1.000	0.000			
/					
cut1	-0.064	0.926			[-1.879,1.751]
cut2	2.291	0.953			[0.422,4.159]
cut3	3.214	0.989			[1.276,5.152]
var(_cons[idnum])	1.356	0.848			[0.398,4.618]

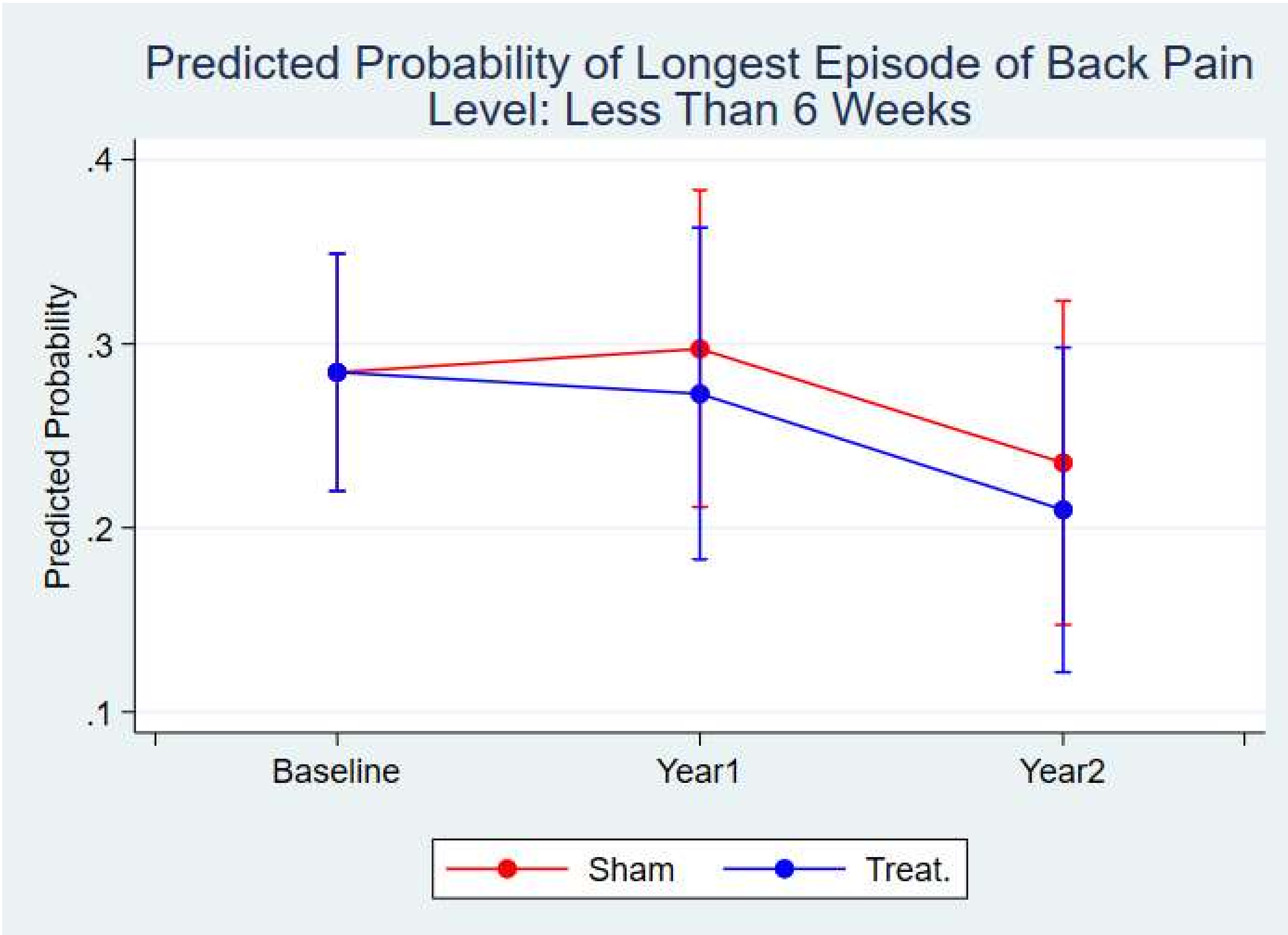
Table 25-14. Marginal Predicted Probability of Longest Episode of Back Pain (None, <6 Weeks, 6-12 Weeks, ≥12 Weeks)

	Predict.Prob.	Std. error	z	p-value	95% CI	
None:Sham@Baseline	.6146778	.0401893	15.29	0.000	.5359083	.6934474
None:Sham@Year1	.5913451	.0691075	8.56	0.000	.455897	.7267932
None:Sham@Year2	.6962031	.0647394	10.75	0.000	.5693162	.82309
None:Treat.@Baseline	.6146778	.0401893	15.29	0.000	.5359083	.6934474
None:Treat.@Year1	.6351622	.0689457	9.21	0.000	.5000311	.7702932
None:Treat.@Year2	.7347697	.0621764	11.82	0.000	.6129063	.8566331
<6Weeks:Sham@Baseline	.2845864	.0329595	8.63	0.000	.219987	.3491858
<6Weeks:Sham@Year1	.2973308	.0439232	6.77	0.000	.2112429	.3834188
<6Weeks:Sham@Year2	.2353557	.0449719	5.23	0.000	.1472125	.3234989
<6Weeks:Treat.@Baseline	.2845864	.0329595	8.63	0.000	.219987	.3491858
<6Weeks:Treat.@Year1	.2728829	.0460129	5.93	0.000	.1826992	.3630665
<6Weeks:Treat.@Year2	.2097523	.0450621	4.65	0.000	.1214323	.2980724
6-12Weeks:Sham@Baseline	.0508482	.0149294	3.41	0.001	.0215871	.0801092
6-12Weeks:Sham@Year1	.0554356	.0198148	2.80	0.005	.0165993	.094272
6-12Weeks:Sham@Year2	.0360874	.0144255	2.50	0.012	.007814	.0643609
6-12Weeks:Treat.@Baseline	.0508482	.0149294	3.41	0.001	.0215871	.0801092
6-12Weeks:Treat.@Year1	.0469521	.0177193	2.65	0.008	.0122228	.0816813
6-12Weeks:Treat.@Year2	.029811	.0125169	2.38	0.017	.0052783	.0543437
≥12Weeks:Sham@Baseline	.0498876	.0157109	3.18	0.001	.0190948	.0806804
≥12Weeks:Sham@Year1	.0558884	.0234476	2.38	0.017	.009932	.1018448
≥12Weeks:Sham@Year2	.0323538	.0151723	2.13	0.033	.0026165	.062091
≥12Weeks:Treat.@Baseline	.0498876	.0157109	3.18	0.001	.0190948	.0806804
≥12Weeks:Treat.@Year1	.0450029	.0192745	2.33	0.020	.0072257	.0827802
≥12Weeks:Treat.@Year2	.0256669	.0122388	2.10	0.036	.0016793	.0496546

1. Both the sham (lifting) and treatment (bending) training decreased the odds of longest episode of back pain (four levels) (odds ratio, p, & [CI's]: 0.881, 0.774, [0.371,2.095] and 0.673, 0.108, [0.416,1.091], sham and treatment training respectively). This represents 12% decreased odds of reporting longest episode of back pain (four levels) for sham subjects receiving the sham (lifting) training and 33% decreased odds of reporting longest episode of back pain (four levels) for the treatment training (bending) over the course of the study.


Predicted Probability of Longest Episode of Back Pain
Level: None (no back pain)
Predicted Probability
.9
.8
.7
.6
.5
.4
Baseline
Year1
Year2
Sham
Treat.

2. The predicted probability of reporting having no back pain was 0.61 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting having no back pain one year after the sham training was 0.59 (4% lower than baseline).
4. The predicted probability of sham subjects reporting having no back pain two years after the sham training and one year after the treatment training was 0.7 (13% higher than baseline and 18% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting having no back pain one year after the treatment training was 0.64 (3% higher than baseline).
6. The predicted probability of treatment subjects reporting having no back pain two years after the first treatment training and one year after the second treatment training was 0.7 (13% higher than baseline and 18% higher than one year after the second treatment training).



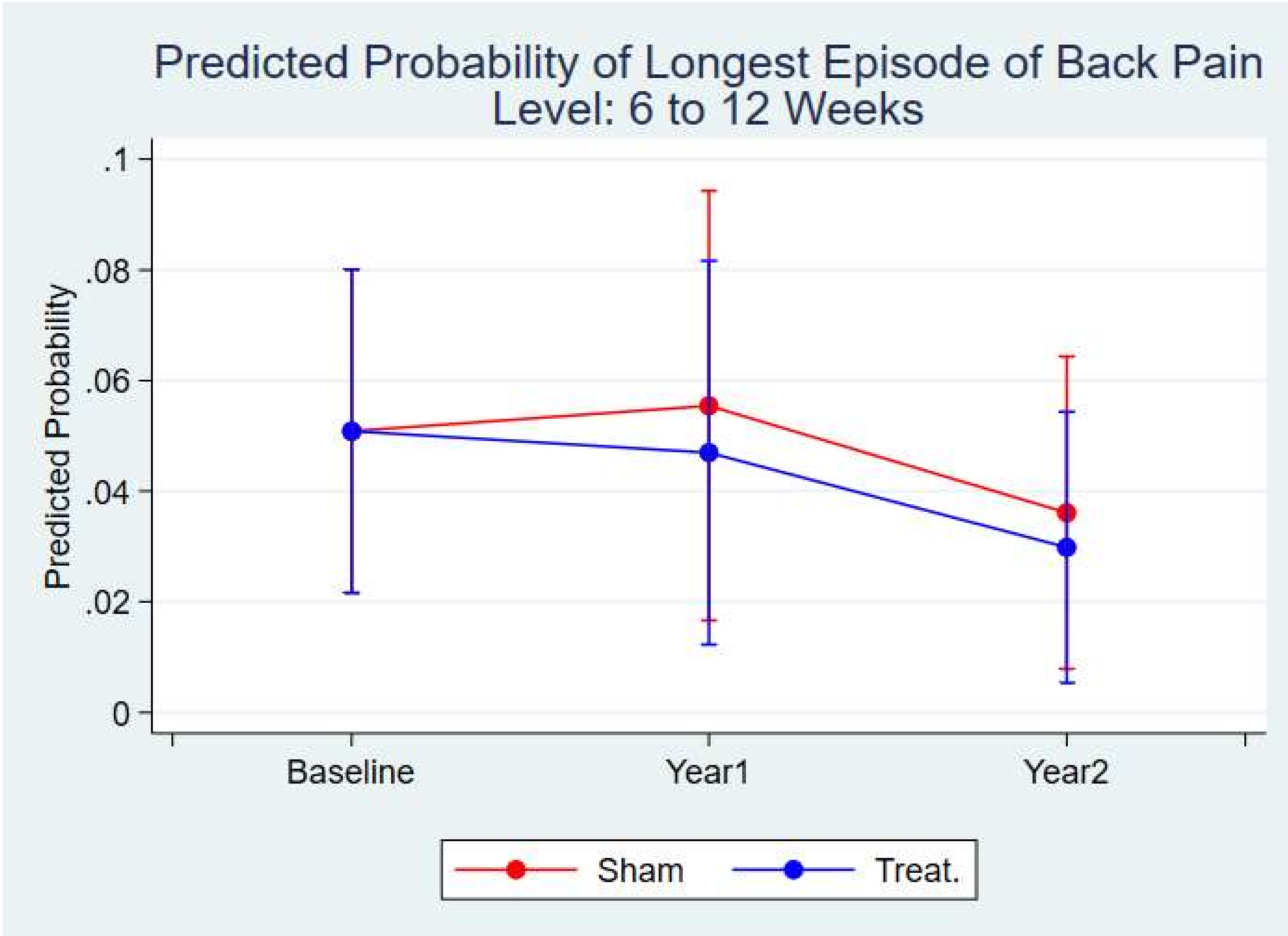
7. The predicted probability of reporting having the longest episode of back pain last less than 6 weeks was 0.28 at baseline (for both sham and treatment subjects).
8. The predicted probability of sham subjects reporting having the longest episode of back pain last less than 6 weeks one year after the sham

training was 0.30 (4% higher than baseline).

9. The predicted probability of sham subjects reporting having the longest episode of back pain last less than 6 weeks two years after the sham training and one year after the treatment training was 0.24 (17% lower than baseline and 21% lower than one year after the sham training).

10. The predicted probability of treatment subjects reporting having the longest episode of back pain last less than 6 weeks one year after the treatment training was 0.27 (4% lower than baseline).

11. The predicted probability of treatment subjects reporting having the longest episode of back pain last less than 6 weeks two years after the first treatment training and one year after the second treatment training was 0.24 (17% lower than baseline and 21% lower than one year after the second treatment training).



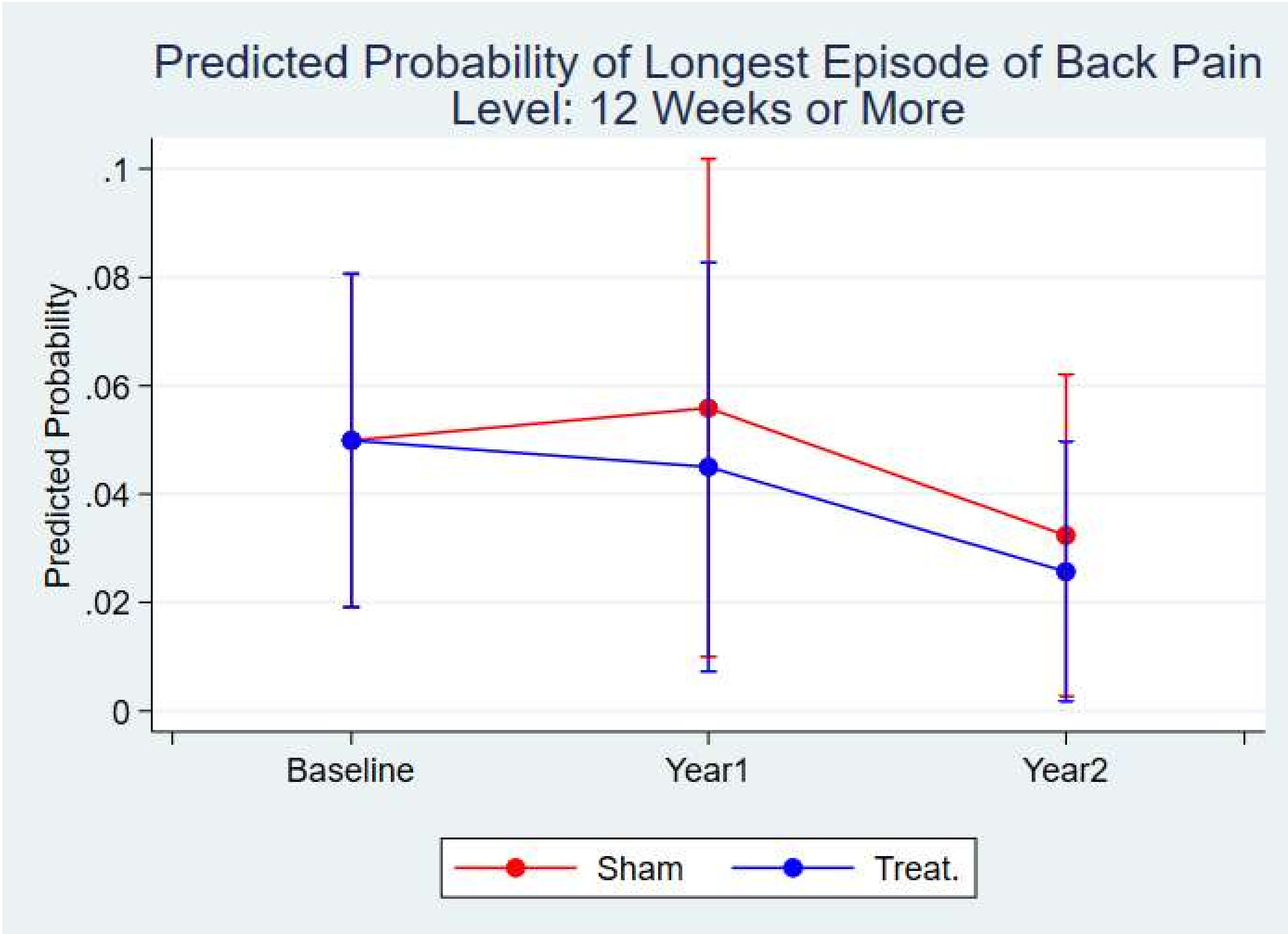
12. The predicted probability of reporting having the longest episode of back pain last between 6 and 12 weeks was 0.05 at baseline (for both sham and treatment subjects).
13. The predicted probability of sham subjects reporting having the longest episode of back pain last between 6 and 12 weeks one year after the

sham training was 0.06 (9% higher than baseline).

14. The predicted probability of sham subjects reporting having the longest episode of back pain last between 6 and 12 weeks two years after the sham training and one year after the treatment training was 0.04 (29% lower than baseline and 35% lower than one year after the sham training).

15. The predicted probability of treatment subjects reporting having the longest episode of back pain last between 6 and 12 weeks one year after the treatment training was 0.05 (8% lower than baseline).

16. The predicted probability of treatment subjects reporting having the longest episode of back pain last between 6 and 12 weeks two years after the first treatment training and one year after the second treatment training was 0.04 (29% lower than baseline and 35% lower than one year after the second treatment training).



17. The predicted probability of reporting having the longest episode of back pain last 12 weeks or more was 0.05 at baseline (for both sham and treatment subjects).
18. The predicted probability of sham subjects reporting having the longest episode of back pain last 12 weeks or more one year after the sham

training was 0.06 (12% higher than baseline).

19. The predicted probability of sham subjects reporting having the longest episode of back pain last 12 weeks or more two years after the sham training and one year after the treatment training was 0.03 (35% lower than baseline and 42% lower than one year after the sham training).

20. The predicted probability of treatment subjects reporting having the longest episode of back pain last 12 weeks or more one year after the treatment training was 0.05 (10% lower than baseline).

21. The predicted probability of treatment subjects reporting having the longest episode of back pain last 12 weeks or more two years after the first treatment training and one year after the second treatment training was 0.03 (35% lower than baseline and 42% lower than one year after the second treatment training).

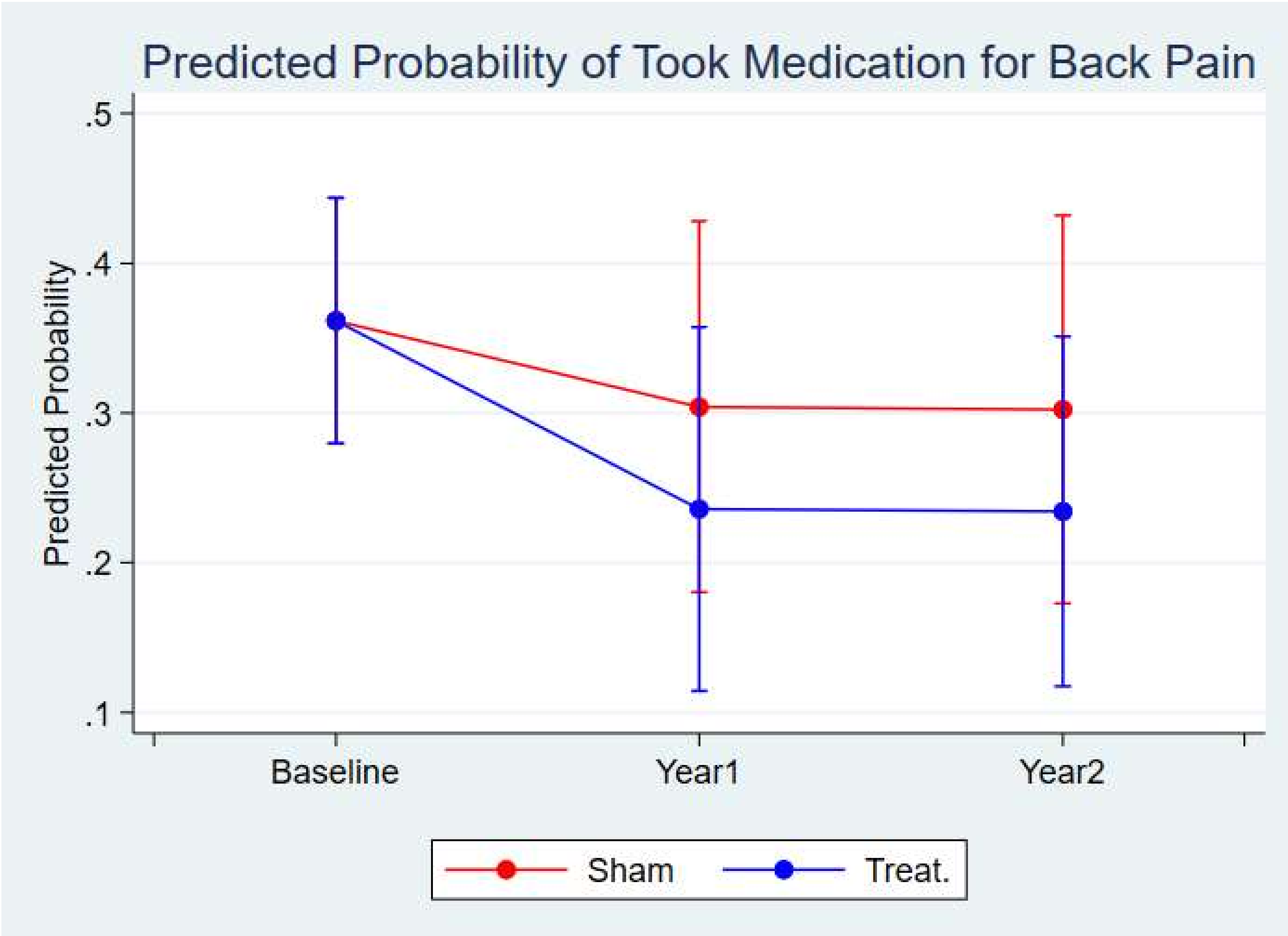
Took Medication for Back Pain

Table 25-15. Mixed Effects Logistic Regression for Took Medication for Back Pain

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Took Medicine for Back Pain					
Sex=Female	0.567	0.383	-0.84	0.401	[0.150,2.134]
Age (Centered)	1.074	0.040	1.94	0.053	[0.999,1.156]
Number of lifts over 25 pounds/day	0.989	0.030	-0.38	0.707	[0.931,1.050]
Tenure	0.978	0.045	-0.48	0.634	[0.895,1.070]
Shift=Night	7.035	6.138	2.24	0.025	[1.272,38.905]
Sleep Time (hrs) on Average per 24hrs	0.783	0.138	-1.39	0.164	[0.554,1.105]
Language (English or Spanish)=Spanish	0.380	0.275	-1.34	0.181	[0.092,1.567]
Have More than UCLA Job=Yes	1.274	1.183	0.26	0.794	[0.207,7.857]
Stress level during past week=Some	4.265	2.627	2.35	0.019	[1.275,14.263]
Stress level during past week=Most	18.460	18.659	2.88	0.004	[2.546,133.844]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	1.080	0.730	0.11	0.910	[0.287,4.063]
Treatment Training (Bending)	0.529	0.198	-1.70	0.089	[0.254,1.102]
Survey=Year1	0.539	0.313	-1.06	0.288	[0.172,1.685]
Survey=Year2	1.000	0.000			
Intercept	0.302	0.432	-0.84	0.402	[0.018,4.985]
/					
var(_cons[idnum])	6.186	3.233			[2.221,17.230]

Table 25-16. Marginal Predicted Probability of Took Medication for Back Pain

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.361594	.0418144	8.65	0.000	.2796393	.4435488
Sham@Year1	.3040538	.0632092	4.81	0.000	.180166	.4279415
Sham@Year2	.3022528	.0661074	4.57	0.000	.1726847	.4318209
Treat.@Baseline	.361594	.0418144	8.65	0.000	.2796393	.4435488
Treat.@Year1	.235765	.0620599	3.80	0.000	.1141297	.3574002
Treat.@Year2	.2341894	.0596677	3.92	0.000	.1172429	.3511359



1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of taking medication for back pain (odds ratio, p, & [CI's]: 1.08, 0.91, [0.287,4.063] and 0.529, 0.089, [0.254,1.102], sham and treatment training respectively). This represents 8% increased odds of reporting taking medication for back pain for sham subjects receiving the sham (lifting) training and 47% decreased odds of

reporting taking medication for back pain for the treatment training (bending) over the course of the study.

2. The predicted probability of reporting taking medication for back pain was 0.36 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting taking medication for back pain one year after the sham training was 0.30 (16% lower than baseline).

4. The predicted probability of sham subjects reporting taking medication for back pain two years after the sham training and one year after the treatment training was 0.3 (16% lower than baseline and 1% lower than one year after the sham training).

5. The predicted probability of treatment subjects reporting taking medication for back pain one year after the treatment training was 0.24 (35% lower than baseline).

6. The predicted probability of treatment subjects reporting taking medication for back pain two years after the first treatment training and one year after the second treatment training was 0.3 (16% lower than baseline and 1% lower than one year after the second treatment training).

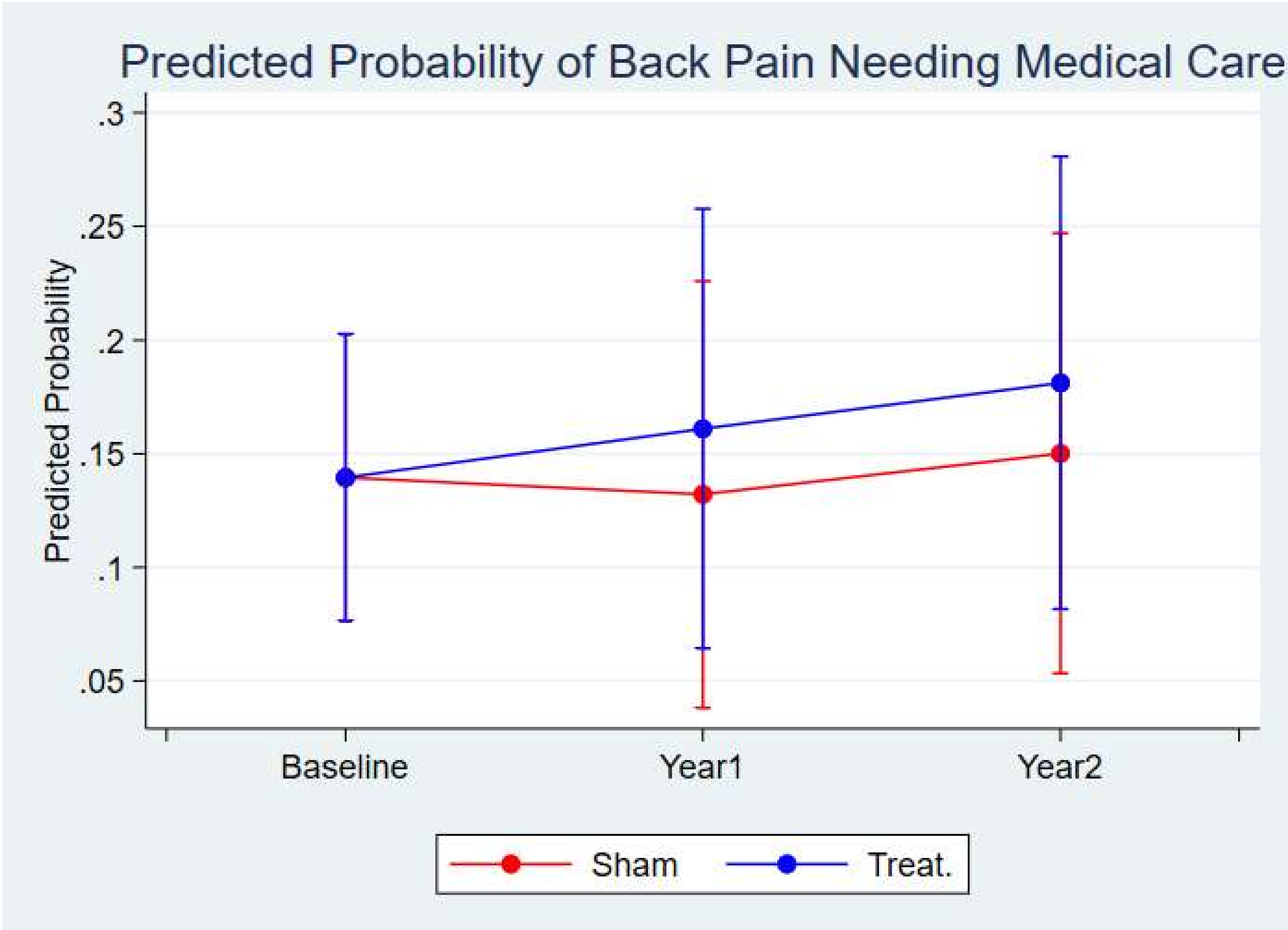
Back Pain Requiring Medical Care

Table 25-17. Mixed Effects Logistic Regression for Back Pain Requiring Medical Care

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Sought Medical Care for Back Pain					
Sex=Female	0.075	0.099	-1.97	0.049	[0.006,0.993]
Age (Centered)	1.040	0.054	0.77	0.444	[0.940,1.152]
Number of lifts over 25 pounds/day	0.997	0.039	-0.08	0.936	[0.924,1.076]
Tenure	1.006	0.063	0.09	0.930	[0.889,1.137]
Shift=Night	2.047	2.545	0.58	0.564	[0.179,23.412]
Sleep Time (hrs) on Average per 24hrs	0.875	0.244	-0.48	0.633	[0.506,1.513]
Language (English or Spanish)=Spanish	0.077	0.169	-1.17	0.241	[0.001,5.584]
Have More than UCLA Job=Yes	0.357	0.518	-0.71	0.478	[0.021,6.128]
Stress level during past week=Some	2.496	2.148	1.06	0.288	[0.462,13.488]
Stress level during past week=Most	1.994	2.504	0.55	0.582	[0.170,23.362]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.831	0.784	-0.20	0.844	[0.131,5.286]
Treatment Training (Bending)	1.495	0.758	0.79	0.427	[0.554,4.038]
Survey=Year1	1.029	0.781	0.04	0.970	[0.232,4.558]
Survey=Year2	1.000	0.000			
Intercept	0.052	0.121	-1.27	0.204	[0.001,5.003]
/					
var(_cons[idnum])	12.934	17.736			[0.880,190.101]

Table 25-18. Marginal Predicted Probability of Back Pain Requiring Medical Care

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.1395245	.0322294	4.33	0.000	.0763561	.202693
Sham@Year1	.1321366	.0478956	2.76	0.006	.038263	.2260102
Sham@Year2	.1501139	.0493956	3.04	0.002	.0533003	.2469275
Treat.@Baseline	.1395245	.0322294	4.33	0.000	.0763561	.202693
Treat.@Year1	.1610074	.0493116	3.27	0.001	.0643585	.2576564
Treat.@Year2	.1811848	.0507966	3.57	0.000	.0816254	.2807443



1. The sham (lifting) training decreased the odds, but the treatment (bending) training increased the odds of receiving medical care for back pain (odds ratio, p, & [CI's]: 0.831, 0.844, [0.131,5.286] and 1.495, 0.427, [0.554,4.038], sham and treatment training respectively). This represents 17% decreased odds of reporting receiving medical care for back pain for sham subjects receiving the sham (lifting) training and 50%

increased odds of reporting receiving medical care for back pain for the treatment training (bending) over the course of the study.
2. The predicted probability of reporting receiving medical care for back pain was 0.14 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting receiving medical care for back pain one year after the sham training was 0.13 (5% lower than baseline).
4. The predicted probability of sham subjects reporting receiving medical care for back pain two years after the sham training and one year after the treatment training was 0.15 (8% higher than baseline and 14% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting receiving medical care for back pain one year after the treatment training was 0.16 (15% higher than baseline).
6. The predicted probability of treatment subjects reporting receiving medical care for back pain two years after the first treatment training and one year after the second treatment training was 0.15 (8% higher than baseline and 14% higher than one year after the second treatment training).

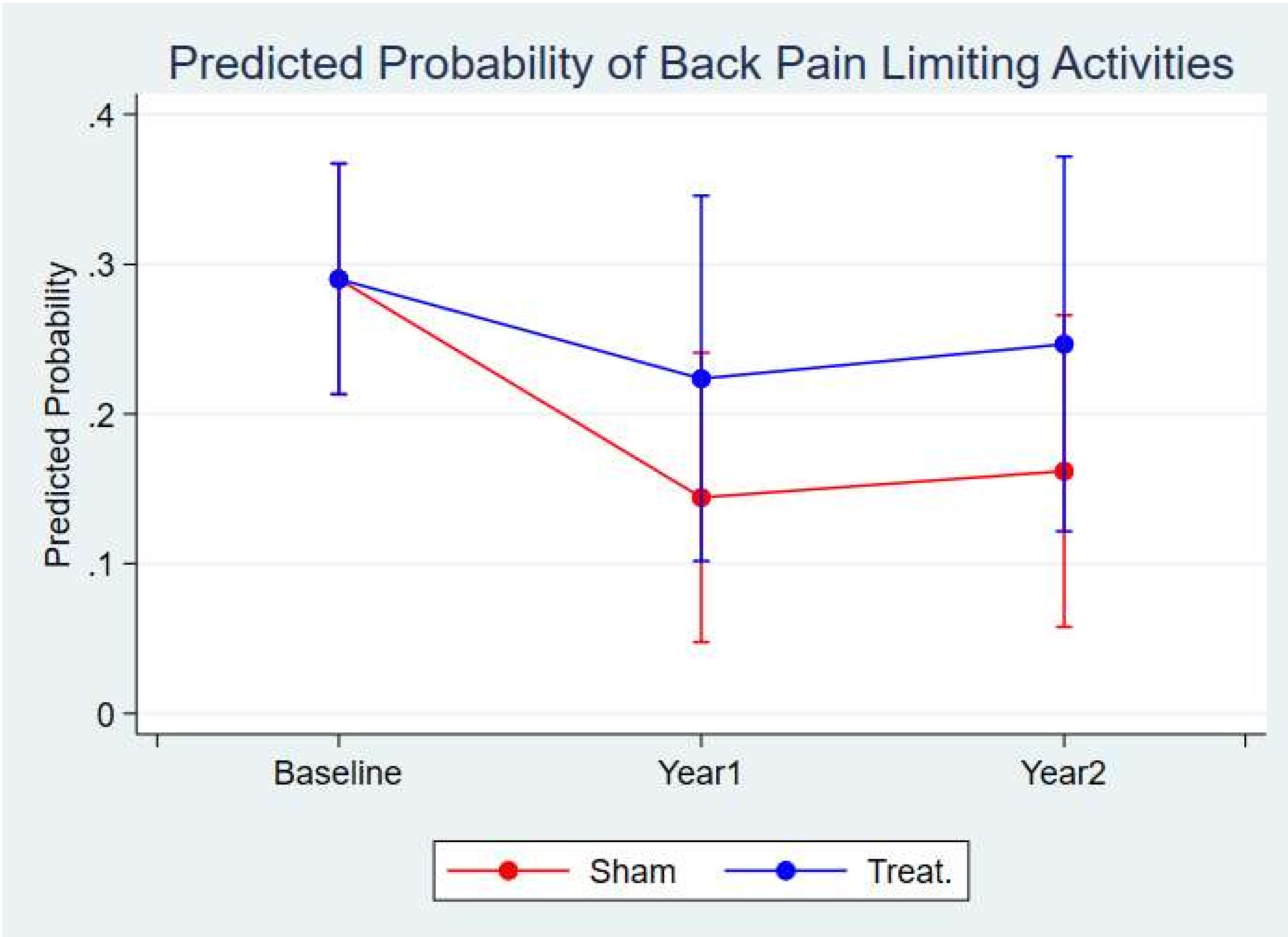
Back Pain Limiting Activities

Table 25-19. Mixed Effects Logistic Regression for Back Pain Limiting Activities

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Impairment due to Back Pain					
Sex=Female	0.248	0.193	-1.79	0.073	[0.054,1.141]
Age (Centered)	1.019	0.038	0.50	0.616	[0.947,1.097]
Number of lifts over 25 pounds/day	1.037	0.034	1.09	0.274	[0.972,1.106]
Tenure	0.994	0.049	-0.12	0.908	[0.904,1.094]
Shift=Night	2.248	1.913	0.95	0.341	[0.424,11.917]
Sleep Time (hrs) on Average per 24hrs	0.920	0.182	-0.42	0.676	[0.624,1.357]
Language (English or Spanish)=Spanish	0.657	0.510	-0.54	0.589	[0.143,3.012]
Have More than UCLA Job=Yes	2.221	2.199	0.81	0.420	[0.319,15.458]
Stress level during past week=Some	4.864	3.338	2.31	0.021	[1.267,18.670]
Stress level during past week=Most	9.910	9.708	2.34	0.019	[1.453,67.592]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.275	0.233	-1.52	0.127	[0.052,1.446]
Treatment Training (Bending)	0.794	0.294	-0.62	0.533	[0.384,1.640]
Survey=Year1	0.611	0.384	-0.78	0.433	[0.178,2.095]
Survey=Year2	1.000	0.000			
Intercept	0.103	0.179	-1.31	0.191	[0.003,3.118]
/					
var(_cons[idnum])	6.806	4.948			[1.637,28.298]

Table 25-20. Marginal Predicted Probability of Back Pain Limiting Activities

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.2900944	.0392755	7.39	0.000	.2131159	.3670729
Sham@Year1	.14419	.0493884	2.92	0.004	.0473906	.2409894
Sham@Year2	.161773	.053178	3.04	0.002	.057546	.266
Treat.@Baseline	.2900944	.0392755	7.39	0.000	.2131159	.3670729
Treat.@Year1	.2236243	.0622281	3.59	0.000	.1016595	.3455892
Treat.@Year2	.2466357	.0638402	3.86	0.000	.1215113	.3717601



1. Both the sham (lifting) and treatment (bending) training decreased the odds of back pain that limited work, school, or leisure activities (odds ratio, p, & [CI's]: 0.275, 0.127, [0.052,1.446] and 0.794, 0.533, [0.384,1.64], sham and treatment training respectively). This represents 73% decreased odds of reporting back pain that limited work, school, or leisure activities for sham subjects receiving the sham (lifting) training and

21% decreased odds of reporting back pain that limited work, school, or leisure activities for the treatment training (bending) over the course of the study.

2. The predicted probability of reporting back pain that limited work, school, or leisure activities was 0.29 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting back pain that limited work, school, or leisure activities one year after the sham training was 0.14 (50% lower than baseline).

4. The predicted probability of sham subjects reporting back pain that limited work, school, or leisure activities two years after the sham training and one year after the treatment training was 0.16 (44% lower than baseline and 12% higher than one year after the sham training).

5. The predicted probability of treatment subjects reporting back pain that limited work, school, or leisure activities one year after the treatment training was 0.22 (23% lower than baseline).

6. The predicted probability of treatment subjects reporting back pain that limited work, school, or leisure activities two years after the first treatment training and one year after the second treatment training was 0.16 (44% lower than baseline and 12% higher than one year after the second treatment training).

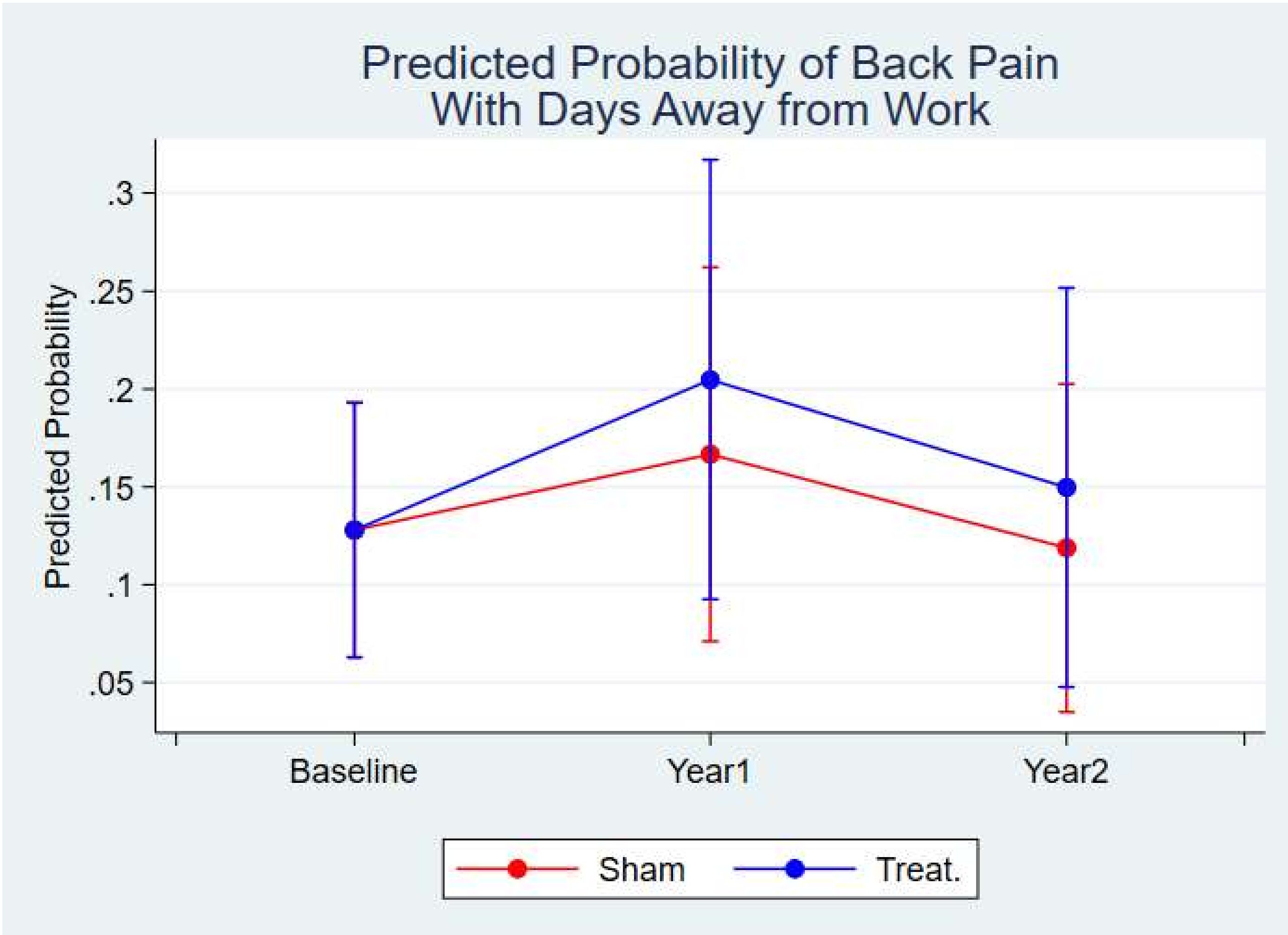
Back Pain Requiring Days Away from Work

Table 25-21. Mixed Effects Logistic Regression for Back Pain Requiring Days Away from Work

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Lost Day or more from work due to Back Pain					
Sex=Female	0.121	0.133	-1.92	0.054	[0.014,1.039]
Age (Centered)	1.022	0.051	0.43	0.664	[0.927,1.127]
Number of lifts over 25 pounds/day	1.018	0.040	0.44	0.656	[0.942,1.099]
Tenure	1.080	0.063	1.32	0.186	[0.964,1.210]
Shift=Night	3.694	4.509	1.07	0.284	[0.338,40.398]
Sleep Time (hrs) on Average per 24hrs	1.022	0.247	0.09	0.927	[0.637,1.642]
Language (English or Spanish)=Spanish	0.895	0.896	-0.11	0.912	[0.126,6.362]
Have More than UCLA Job=Yes	2.999	3.575	0.92	0.357	[0.290,31.032]
Stress level during past week=Some	2.385	2.173	0.95	0.340	[0.400,14.225]
Stress level during past week=Most	0.310	0.574	-0.63	0.527	[0.008,11.728]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.689	0.656	-0.39	0.696	[0.106,4.457]
Treatment Training (Bending)	1.217	0.561	0.43	0.670	[0.493,3.004]
Survey=Year1	2.844	2.210	1.35	0.178	[0.620,13.039]
Survey=Year2	1.000	0.000			
Intercept	0.006	0.017	-1.87	0.062	[0.000,1.276]
/					
var(_cons[idnum])	9.819	11.583			[0.973,99.114]

Table 25-22. Marginal Predicted Probability of Back Pain Requiring Days Away from Work

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.1279156	.0332107	3.85	0.000	.0628239	.1930073
Sham@Year1	.1666469	.0487786	3.42	0.001	.0710427	.2622511
Sham@Year2	.1188512	.0427175	2.78	0.005	.0351264	.2025759
Treat.@Baseline	.1279156	.0332107	3.85	0.000	.0628239	.1930073
Treat.@Year1	.2047728	.0572678	3.58	0.000	.0925301	.3170156
Treat.@Year2	.1497148	.0520614	2.88	0.004	.0476763	.2517533



1. The sham (lifting) training decreased the odds, but the treatment (bending) training increased the odds of back pain resulting in at least one day away from work (odds ratio, p, & [CI's]: 0.689, 0.696, [0.106,4.457] and 1.217, 0.67, [0.493,3.004], sham and treatment training respectively). This represents 31% decreased odds of reporting back pain resulting in at least one day away from work for sham subjects

receiving the sham (lifting) training and 22% increased odds of reporting back pain resulting in at least one day away from work for the treatment training (bending) over the course of the study.

2. The predicted probability of reporting back pain resulting in at least one day away from work was 0.13 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting back pain resulting in at least one day away from work one year after the sham training was 0.17 (30% higher than baseline).

4. The predicted probability of sham subjects reporting back pain resulting in at least one day away from work two years after the sham training and one year after the treatment training was 0.12 (7% lower than baseline and 29% lower than one year after the sham training).

5. The predicted probability of treatment subjects reporting back pain resulting in at least one day away from work one year after the treatment training was 0.20 (60% higher than baseline).

6. The predicted probability of treatment subjects reporting back pain resulting in at least one day away from work two years after the first treatment training and one year after the second treatment training was 0.12 (7% lower than baseline and 29% lower than one year after the second treatment training).

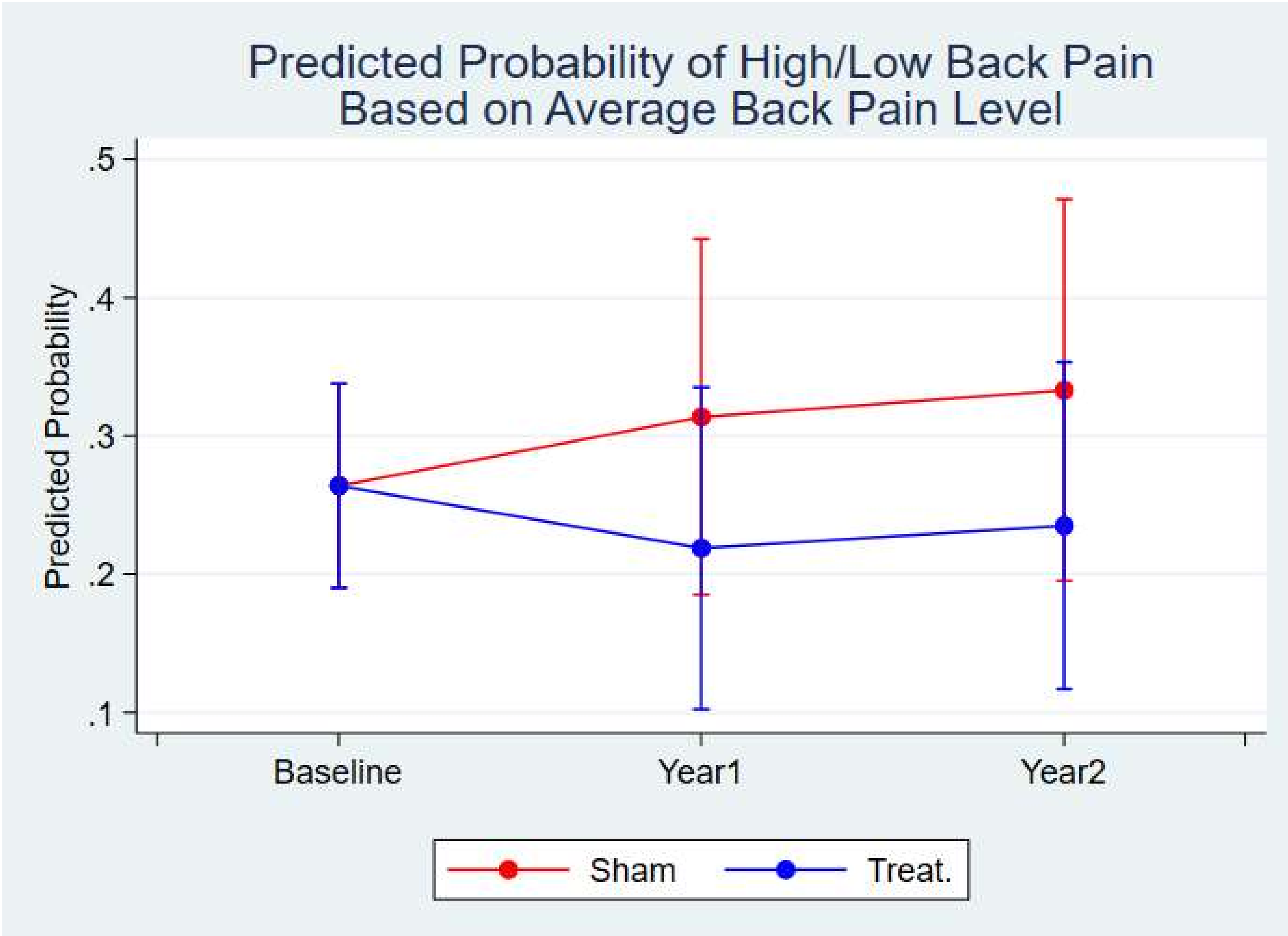
High/Low Back Pain Based on Average Back Pain Level

Table 25-23. Mixed Effects Logistic Regression for High/Low Back Pain Based on Average Back Pain Level

	Mixed Effects Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Average Back Pain - 2 Levels					
Sex=Female	0.204	0.122	-2.66	0.008	[0.063,0.659]
Age (Centered)	0.993	0.027	-0.24	0.807	[0.941,1.049]
Number of lifts over 25 pounds/day	1.010	0.025	0.39	0.693	[0.962,1.061]
Tenure	0.950	0.037	-1.31	0.191	[0.879,1.026]
Shift=Night	3.697	2.406	2.01	0.044	[1.033,13.235]
Sleep Time (hrs) on Average per 24hrs	0.860	0.131	-0.99	0.323	[0.639,1.159]
Language (English or Spanish)=Spanish	0.916	0.565	-0.14	0.887	[0.273,3.071]
Have More than UCLA Job=Yes	0.628	0.482	-0.61	0.544	[0.140,2.825]
Stress level during past week=Some	7.962	4.360	3.79	0.000	[2.722,23.290]
Stress level during past week=Most	7.398	5.811	2.55	0.011	[1.587,34.493]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	1.986	1.128	1.21	0.227	[0.652,6.046]
Treatment Training (Bending)	0.880	0.267	-0.42	0.674	[0.486,1.595]
Survey=Year1	0.757	0.378	-0.56	0.577	[0.284,2.014]
Survey=Year2	1.000	0.000			
Intercept	0.147	0.179	-1.58	0.114	[0.014,1.586]
/					
var(_cons[idnum])	2.444	1.557			[0.701,8.519]

Table 25-24. Marginal Predicted Probability of High/Low Back Pain Based on Average Back Pain Level

	Predict.Prob.	Std. error	z	p-value	95% CI	
Sham@Baseline	.2638336	.0376729	7.00	0.000	.1899961	.3376711
Sham@Year1	.313581	.0656783	4.77	0.000	.1848539	.4423081
Sham@Year2	.333013	.0704025	4.73	0.000	.1950266	.4709994
Treat.@Baseline	.2638336	.0376729	7.00	0.000	.1899961	.3376711
Treat.@Year1	.2186971	.0593935	3.68	0.000	.102288	.3351062
Treat.@Year2	.2349442	.0604117	3.89	0.000	.1165394	.353349



1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of high average back pain (a rating of 4 or more on a 0-10-point scale) (odds ratio, p, & [CI's]: 1.986, 0.227, [0.652,6.046] and 0.88, 0.674, [0.486,1.595], sham and treatment training respectively). This represents 99% increased odds of reporting high average back pain (a rating of 4 or more on a 0-10-point scale) for sham

subjects receiving the sham (lifting) training and 12% decreased odds of reporting high average back pain (a rating of 4 or more on a 0-10-point scale) for the treatment training (bending) over the course of the study.

2. The predicted probability of reporting high average back pain (a rating of 4 or more on a 0-10-point scale) was 0.26 at baseline (for both sham and treatment subjects).

3. The predicted probability of sham subjects reporting high average back pain (a rating of 4 or more on a 0-10-point scale) one year after the sham training was 0.31 (19% higher than baseline).

4. The predicted probability of sham subjects reporting high average back pain (a rating of 4 or more on a 0-10-point scale) two years after the sham training and one year after the treatment training was 0.33 (26% higher than baseline and 6% higher than one year after the sham training).

5. The predicted probability of treatment subjects reporting high average back pain (a rating of 4 or more on a 0-10-point scale) one year after the treatment training was 0.22 (17% lower than baseline).

6. The predicted probability of treatment subjects reporting high average back pain (a rating of 4 or more on a 0-10-point scale) two years after the first treatment training and one year after the second treatment training was 0.33 (26% higher than baseline and 6% higher than one year after the second treatment training).

Four Levels of Back Pain Based on Average Back Pain Level

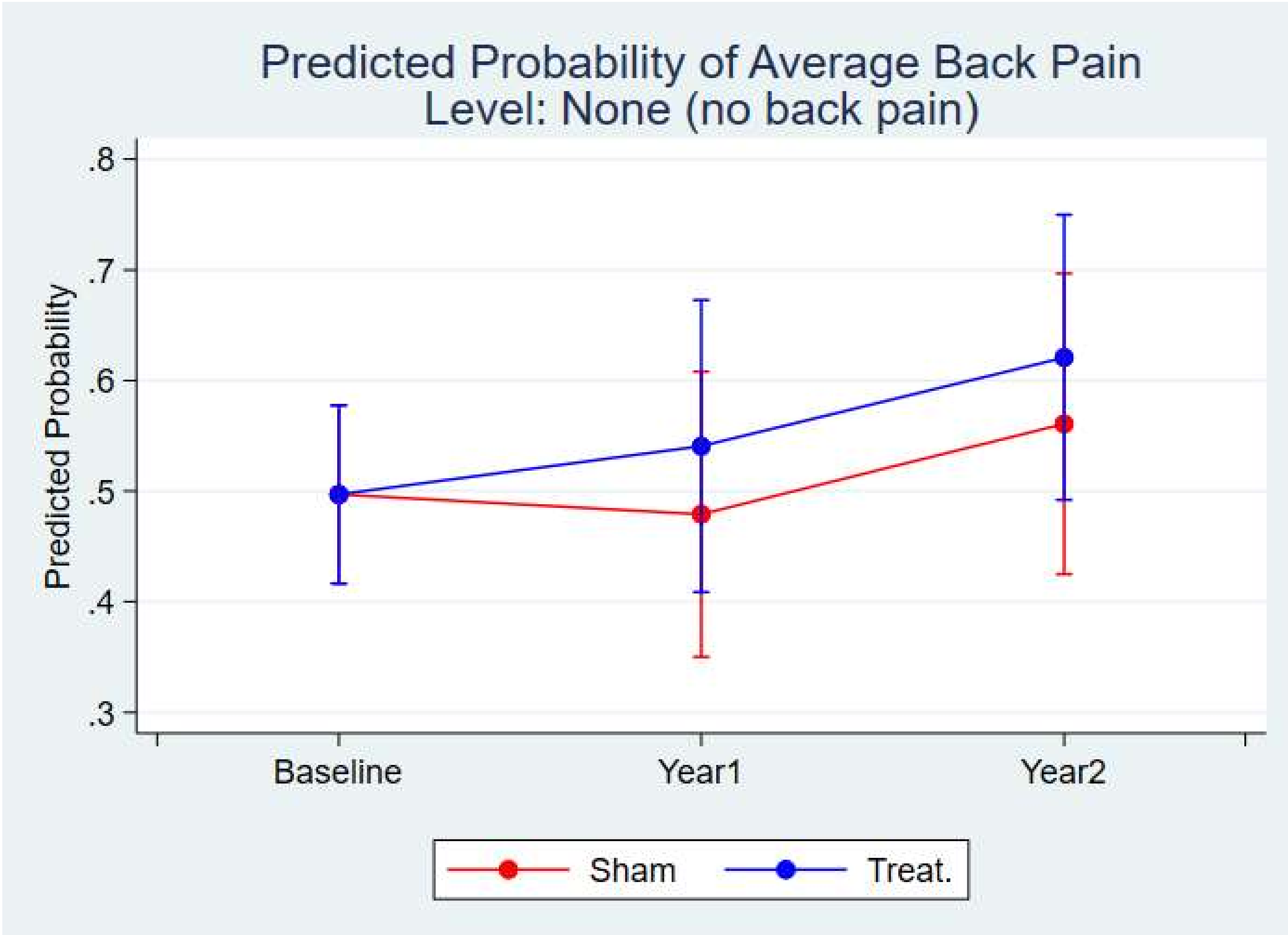
Table 25-25. Mixed Effects Ordered Logistic Regression for Four Levels of Back Pain Based on Average Back Pain Level

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Average Back Pain - 4 Levels					
Sex=Female	0.366	0.162	-2.27	0.023	[0.154,0.870]
Age (Centered)	0.999	0.022	-0.04	0.967	[0.956,1.044]
Number of lifts over 25 pounds/day	1.003	0.019	0.14	0.889	[0.966,1.041]
Tenure	0.982	0.029	-0.61	0.540	[0.926,1.041]
Shift=Night	2.569	1.286	1.88	0.060	[0.962,6.855]
Sleep Time (hrs) on Average per 24hrs	0.873	0.099	-1.19	0.233	[0.698,1.091]
Language (English or Spanish)=Spanish	0.783	0.360	-0.53	0.595	[0.318,1.928]
Have More than UCLA Job=Yes	0.723	0.449	-0.52	0.602	[0.214,2.440]
Stress level during past week=Some	3.818	1.537	3.33	0.001	[1.734,8.405]
Stress level during past week=Most	3.989	2.368	2.33	0.020	[1.246,12.767]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.993	0.438	-0.02	0.987	[0.418,2.359]
Treatment Training (Bending)	0.672	0.154	-1.74	0.082	[0.430,1.052]
Survey=Year1	1.128	0.421	0.32	0.746	[0.543,2.343]
Survey=Year2	1.000	0.000			
/					
cut1	-0.165	0.941			[-2.009,1.680]
cut2	1.251	0.943			[-0.598,3.100]
cut3	2.960	0.984			[1.032,4.887]
var(_cons[idnum])	2.420	1.069			[1.018,5.753]

1. Both the sham (lifting) and treatment (bending) training decreased the odds of average back pain (four levels) (odds ratio, p, & [CI's]: 0.993, 0.987, [0.418,2.359] and 0.672, 0.082, [0.43,1.052], sham and treatment training respectively). This represents 1% decreased odds of reporting average back pain (four levels) for sham subjects receiving the sham (lifting) training and 33% decreased odds of reporting average back pain (four levels) for the treatment training (bending) over the course of the study.

Table 25-26. Marginal Predicted Probability of Four Levels of Back Pain Based on Average Back Pain Level

	Predict.Prob.	Std. error	z	p-value	95% CI	
None:Sham@Baseline	.4969609	.041157	12.07	0.000	.4162947	.5776271
None:Sham@Year1	.4789893	.0658627	7.27	0.000	.3499008	.6080778
None:Sham@Year2	.5608216	.0694268	8.08	0.000	.4247475	.6968956
None:Treat.@Baseline	.4969609	.041157	12.07	0.000	.4162947	.5776271
None:Treat.@Year1	.5406789	.0674502	8.02	0.000	.408479	.6728788
None:Treat.@Year2	.6208463	.0657173	9.45	0.000	.4920428	.7496498
Mild-Moderate:Sham@Baseline	.2130898	.0273763	7.78	0.000	.1594331	.2667464
Mild-Moderate:Sham@Year1	.2155412	.0284062	7.59	0.000	.159866	.2712164
Mild-Moderate:Sham@Year2	.2012046	.0296204	6.79	0.000	.1431496	.2592596
Mild-Moderate:Treat.@Baseline	.2130898	.0273763	7.78	0.000	.1594331	.2667464
Mild-Moderate:Treat.@Year1	.2054726	.0284241	7.23	0.000	.1497623	.2611829
Mild-Moderate:Treat.@Year2	.1857896	.0292802	6.35	0.000	.1284016	.2431777
Severe:Sham@Baseline	.1787237	.0271485	6.58	0.000	.1255135	.2319339
Severe:Sham@Year1	.1857595	.0340636	5.45	0.000	.1189961	.2525228
Severe:Sham@Year2	.1533314	.0330981	4.63	0.000	.0884603	.2182024
Severe:Treat.@Baseline	.1787237	.0271485	6.58	0.000	.1255135	.2319339
Severe:Treat.@Year1	.1613829	.0334994	4.82	0.000	.0957253	.2270405
Severe:Treat.@Year2	.1293269	.03063	4.22	0.000	.0692932	.1893605
Very Severe:Sham@Baseline	.1112256	.0240308	4.63	0.000	.0641261	.1583252
Very Severe:Sham@Year1	.11971	.0355967	3.36	0.001	.0499416	.1894783
Very Severe:Sham@Year2	.0846425	.0285634	2.96	0.003	.0286592	.1406258
Very Severe:Treat.@Baseline	.1112256	.0240308	4.63	0.000	.0641261	.1583252
Very Severe:Treat.@Year1	.0924657	.0305248	3.03	0.002	.0326382	.1522931
Very Severe:Treat.@Year2	.0640372	.0228983	2.80	0.005	.0191573	.1089171



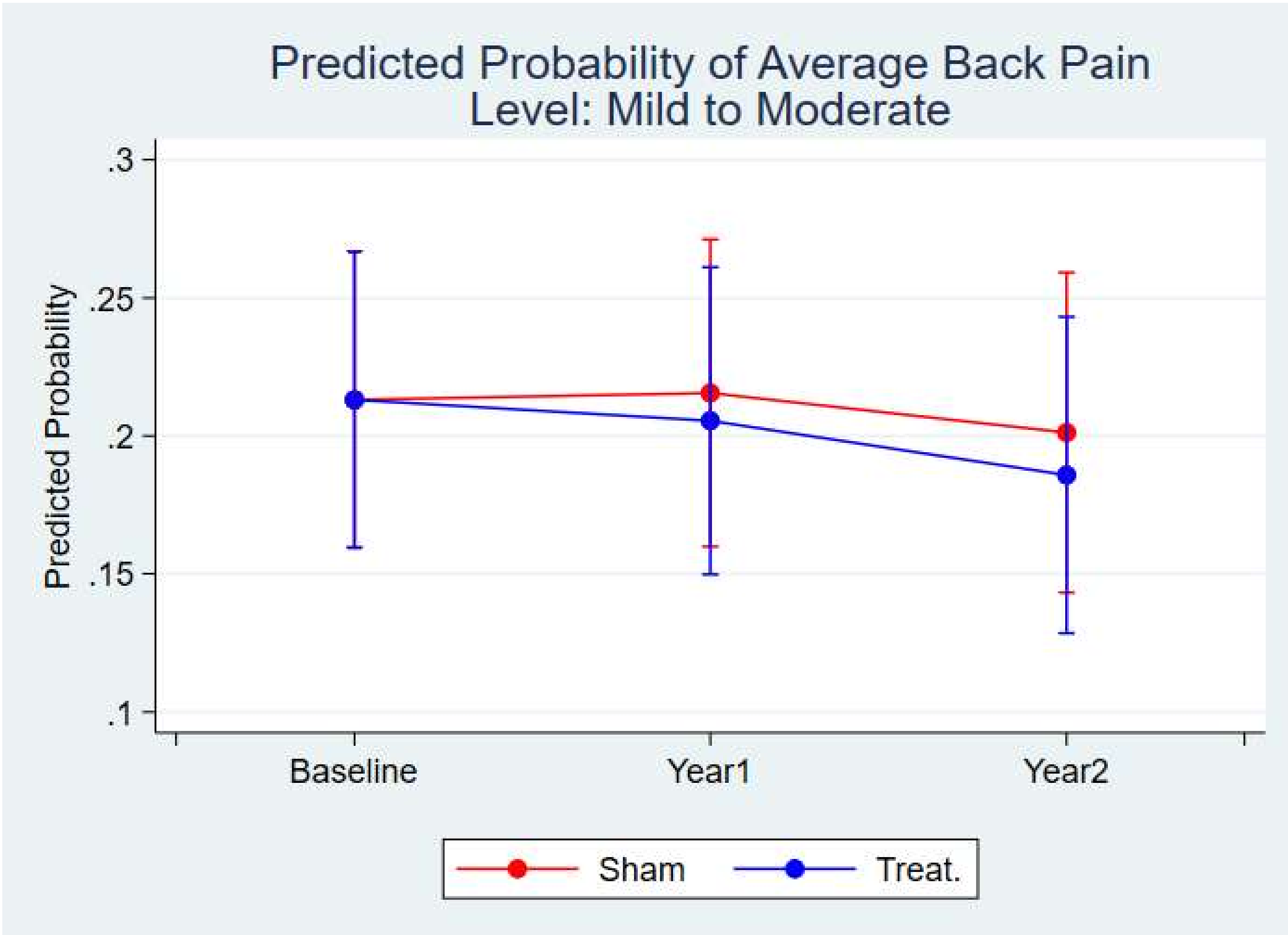
2. The predicted probability of reporting no average back pain (0 on a 0-10-point scale) was 0.5 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting no average back pain (0 on a 0-10-point scale) one year after the sham training was 0.48

(4% lower than baseline).

4. The predicted probability of sham subjects reporting no average back pain (0 on a 0-10-point scale) two years after the sham training and one year after the treatment training was 0.56 (13% higher than baseline and 17% higher than one year after the sham training).

5. The predicted probability of treatment subjects reporting no average back pain (0 on a 0-10-point scale) one year after the treatment training was 0.54 (9% higher than baseline).

6. The predicted probability of treatment subjects reporting no average back pain (0 on a 0-10-point scale) two years after the first treatment training and one year after the second treatment training was 0.56 (13% higher than baseline and 17% higher than one year after the second treatment training).



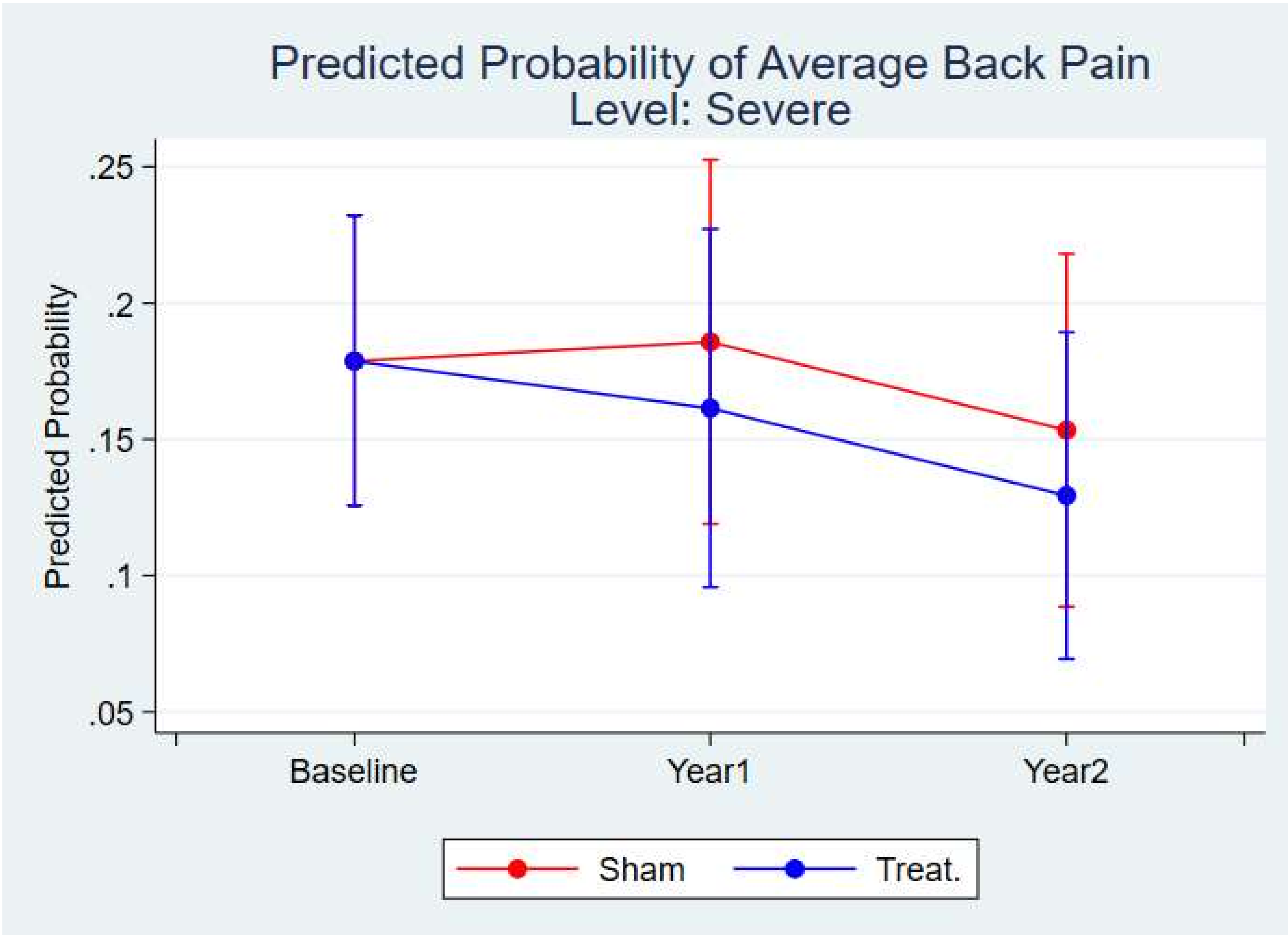
7. The predicted probability of reporting mild-to-moderate average back pain (1-3 on a 0-10-point scale) was 0.21 at baseline (for both sham and treatment subjects).
8. The predicted probability of sham subjects reporting mild-to-moderate average back pain (1-3 on a 0-10-point scale) one year after the sham

training was 0.22 (1% higher than baseline).

9. The predicted probability of sham subjects reporting mild-to-moderate average back pain (1-3 on a 0-10-point scale) two years after the sham training and one year after the treatment training was 0.2 (6% lower than baseline and 7% lower than one year after the sham training).

10. The predicted probability of treatment subjects reporting mild-to-moderate average back pain (1-3 on a 0-10-point scale) one year after the treatment training was 0.21 (4% lower than baseline).

11. The predicted probability of treatment subjects reporting mild-to-moderate average back pain (1-3 on a 0-10-point scale) two years after the first treatment training and one year after the second treatment training was 0.2 (6% lower than baseline and 7% lower than one year after the second treatment training).



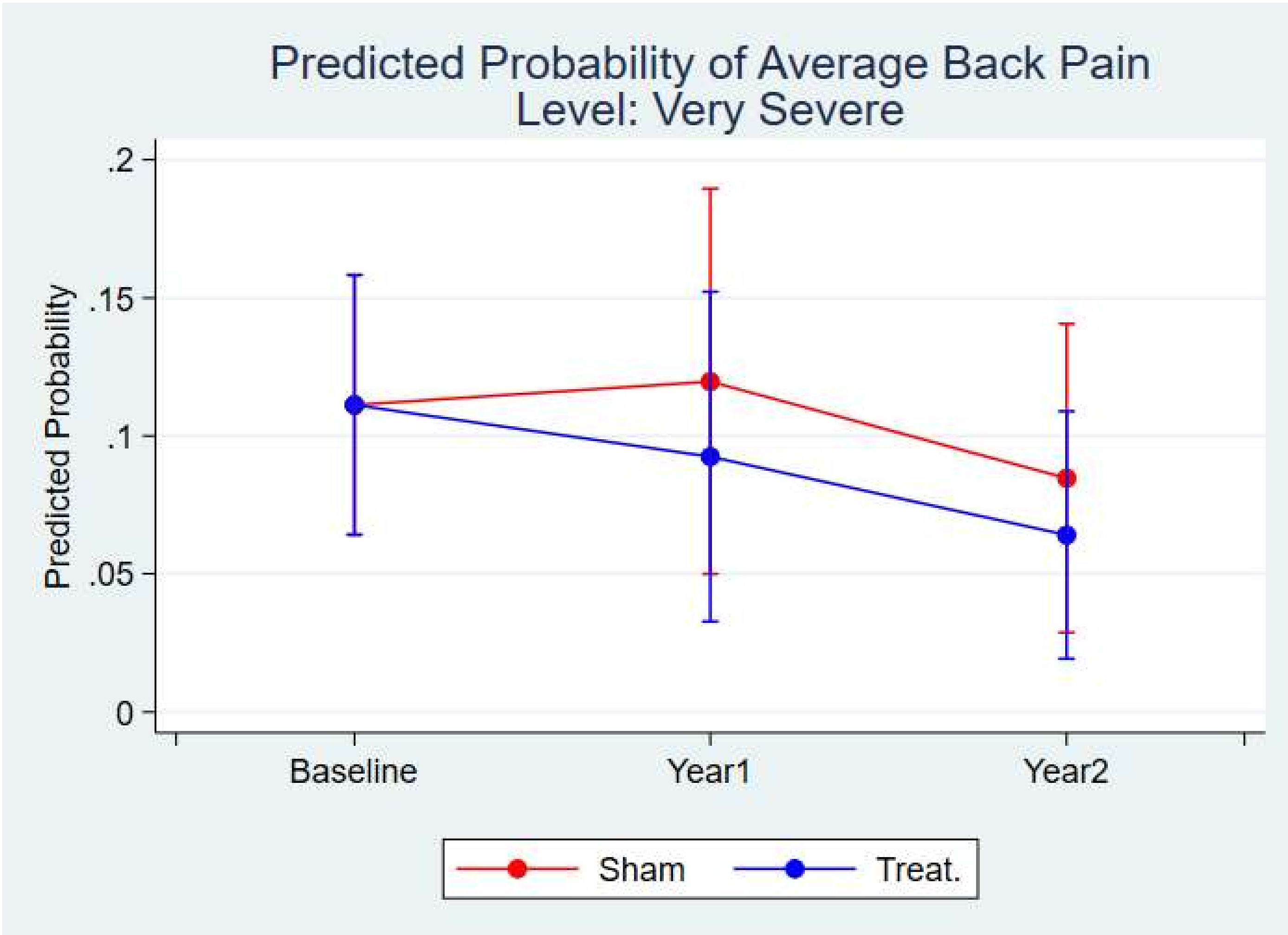
12. The predicted probability of reporting severe average back pain (4-6 on a 0-10-point scale) was 0.18 at baseline (for both sham and treatment subjects).
13. The predicted probability of sham subjects reporting severe average back pain (4-6 on a 0-10-point scale) one year after the sham training

was 0.19 (4% higher than baseline).

14. The predicted probability of sham subjects reporting severe average back pain (4-6 on a 0-10-point scale) two years after the sham training and one year after the treatment training was 0.15 (14% lower than baseline and 17% lower than one year after the sham training).

15. The predicted probability of treatment subjects reporting severe average back pain (4-6 on a 0-10-point scale) one year after the treatment training was 0.16 (10% lower than baseline).

16. The predicted probability of treatment subjects reporting severe average back pain (4-6 on a 0-10-point scale) two years after the first treatment training and one year after the second treatment training was 0.15 (14% lower than baseline and 17% lower than one year after the second treatment training).



17. The predicted probability of reporting very severe average back pain (7-10 on a 0-10-point scale) was 0.11 at baseline (for both sham and treatment subjects).

18. The predicted probability of sham subjects reporting very severe average back pain (7-10 on a 0-10-point scale) one year after the sham

training was 0.12 (8% higher than baseline).

19. The predicted probability of sham subjects reporting very severe average back pain (7-10 on a 0-10-point scale) two years after the sham training and one year after the treatment training was 0.08 (24% lower than baseline and 29% lower than one year after the sham training).

20. The predicted probability of treatment subjects reporting very severe average back pain (7-10 on a 0-10-point scale) one year after the treatment training was 0.09 (17% lower than baseline).

21. The predicted probability of treatment subjects reporting very severe average back pain (7-10 on a 0-10-point scale) two years after the first treatment training and one year after the second treatment training was 0.08 (24% lower than baseline and 29% lower than one year after the second treatment training).

Total Days of Back Pain Past Year - 3 Levels

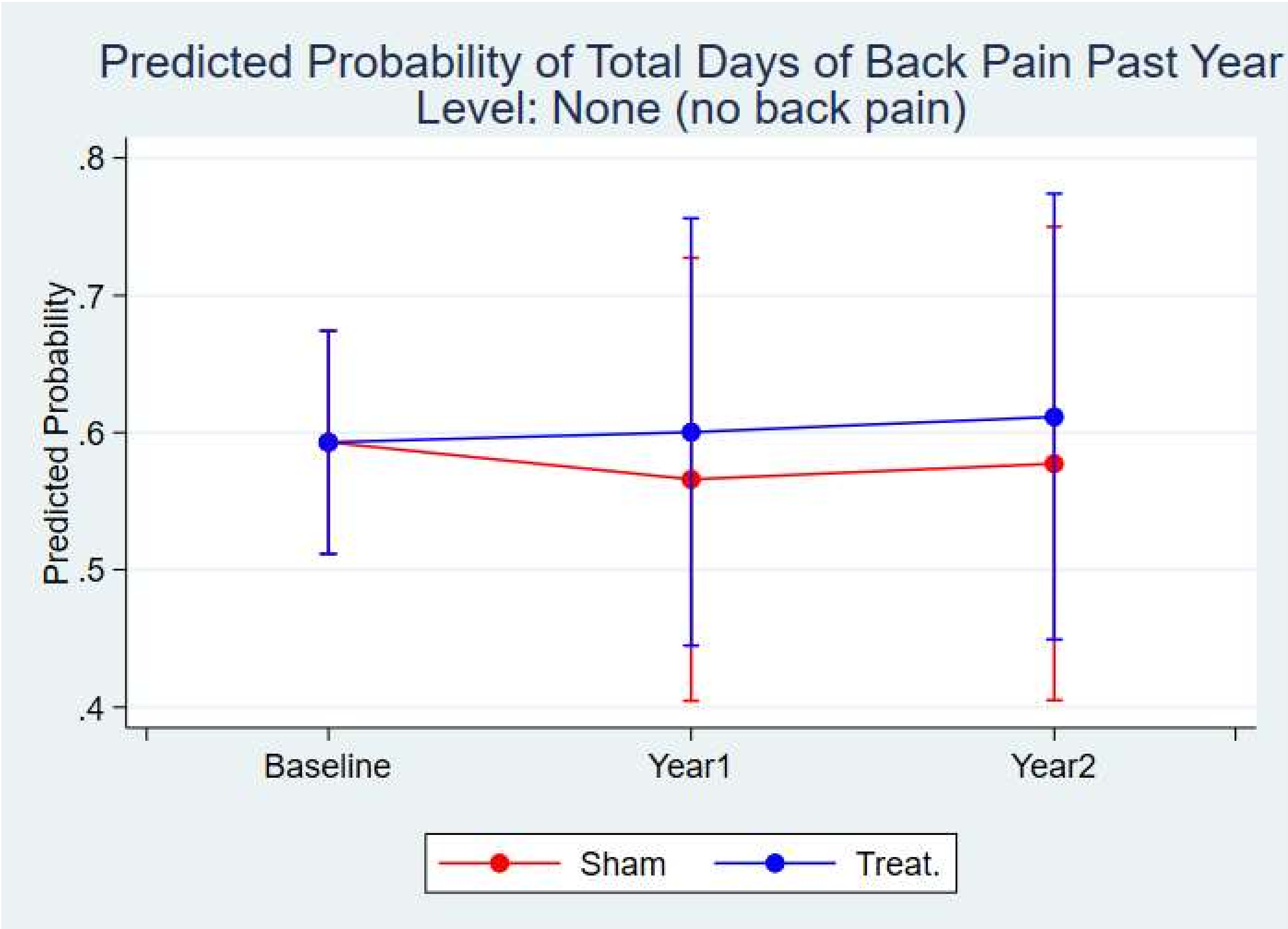
Table 25-27. Mixed Effects Ordered Logistic Regression for Total Days of Back Pain Past Year - 3 Levels

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Total Days with Back Pain - Three Levels					
Sex=Female	0.601	0.244	-1.25	0.211	[0.271,1.334]
Age (Centered)	1.013	0.021	0.61	0.540	[0.972,1.055]
Number of lifts over 25 pounds/day	1.007	0.020	0.35	0.724	[0.968,1.048]
Tenure	0.981	0.027	-0.69	0.492	[0.930,1.035]
Shift=Night	2.356	1.113	1.81	0.070	[0.934,5.947]
Sleep Time (hrs) on Average per 24hrs	0.810	0.097	-1.75	0.079	[0.640,1.025]
Language (English or Spanish)=Spanish	0.772	0.362	-0.55	0.581	[0.308,1.936]
Have More than UCLA Job=Yes	1.083	0.648	0.13	0.894	[0.336,3.497]
Stress level during past week=Some	3.135	1.282	2.80	0.005	[1.407,6.986]
Stress level during past week=Most	8.287	5.069	3.46	0.001	[2.498,27.486]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	1.154	0.569	0.29	0.771	[0.439,3.036]
Treatment Training (Bending)	0.947	0.244	-0.21	0.834	[0.571,1.571]
Survey=Year1	1.011	0.440	0.03	0.980	[0.431,2.373]
Survey=Year2	1.000	0.000			
/					
cut1	0.058	0.924			[-1.753,1.869]
cut2	1.607	0.939			[-0.233,3.448]
var(_cons[idnum])	1.178	0.877			[0.274,5.070]

1. The sham (lifting) training increased the odds, but the treatment (bending) training decreased the odds of total days of back pain (three levels) (odds ratio, p, & [CI's]: 1.154, 0.771, [0.439,3.036] and 0.947, 0.834, [0.571,1.571], sham and treatment training respectively). This represents 15% increased odds of reporting total days of back pain (three levels) for sham subjects receiving the sham (lifting) training and 5% decreased odds of reporting total days of back pain (three levels) for the treatment training (bending) over the course of the study.

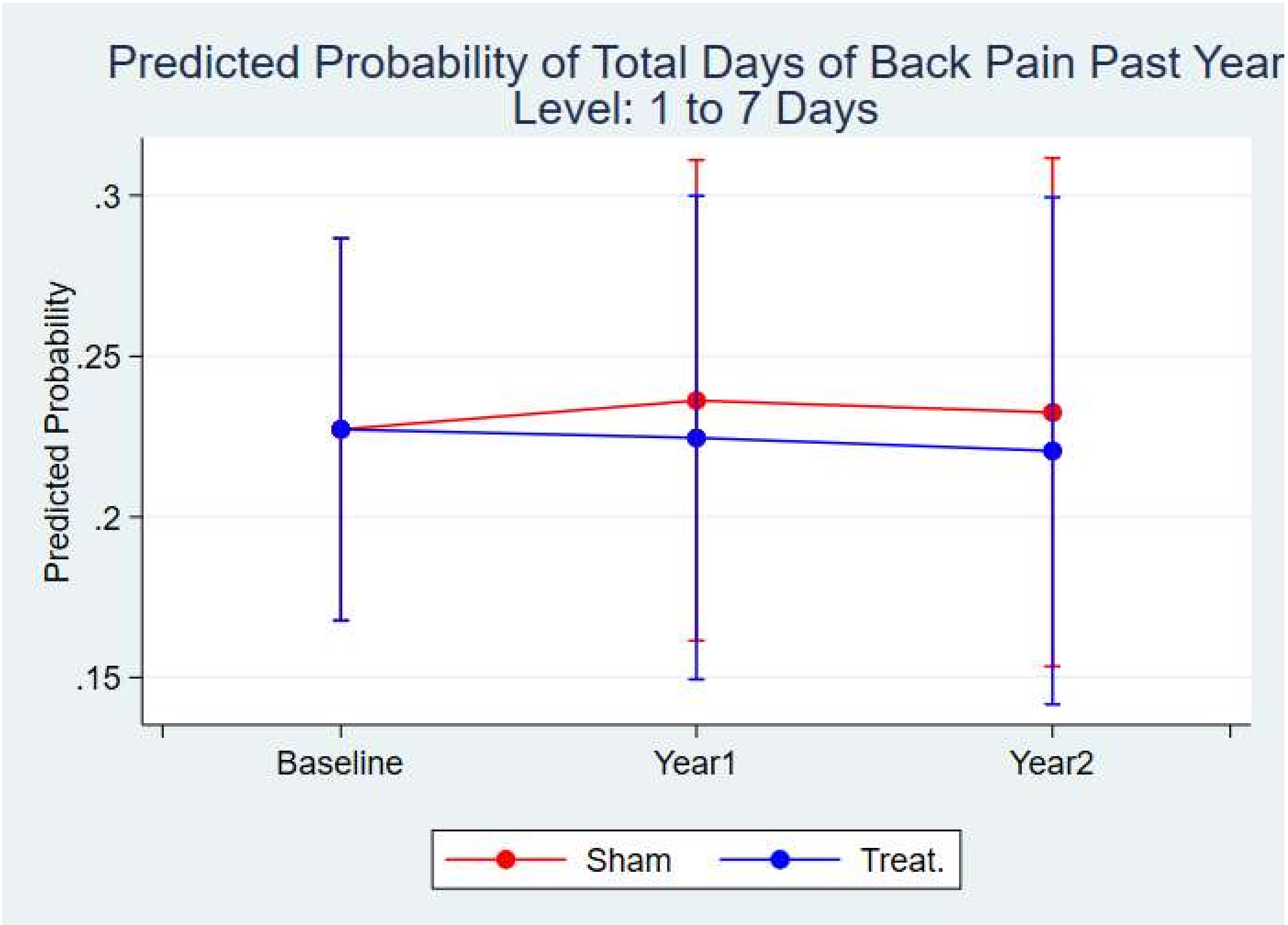
Table 25-28. Marginal Predicted Probability of Total Days of Back Pain Past Year - None, 1-7 Days, 8-365 Days

	Predict.Prob.	Std. error	z	p-value	95% CI	
None:Sham@Baseline	.5928982	.0415218	14.28	0.000	.5115169	.6742795
None:Sham@Year1	.5658926	.0824434	6.86	0.000	.4043066	.7274787
None:Sham@Year2	.5773239	.0880326	6.56	0.000	.4047831	.7498647
None:Treat.@Baseline	.5928982	.0415218	14.28	0.000	.5115169	.6742795
None:Treat.@Year1	.6003095	.0794203	7.56	0.000	.4446485	.7559705
None:Treat.@Year2	.6114885	.0828954	7.38	0.000	.4490165	.7739606
Mild-Moderate:Sham@Baseline	.2272355	.0303572	7.49	0.000	.1677364	.2867346
Mild-Moderate:Sham@Year1	.2362193	.0381452	6.19	0.000	.1614562	.3109824
Mild-Moderate:Sham@Year2	.232523	.0403441	5.76	0.000	.15345	.311596
Mild-Moderate:Treat.@Baseline	.2272355	.0303572	7.49	0.000	.1677364	.2867346
Mild-Moderate:Treat.@Year1	.2246194	.0383726	5.85	0.000	.1494106	.2998283
Mild-Moderate:Treat.@Year2	.2205536	.040202	5.49	0.000	.1417592	.299348
Severe:Sham@Baseline	.1798663	.0305969	5.88	0.000	.1198975	.239835
Severe:Sham@Year1	.1978881	.0585331	3.38	0.001	.0831652	.3126109
Severe:Sham@Year2	.1901531	.0603069	3.15	0.002	.0719537	.3083525
Severe:Treat.@Baseline	.1798663	.0305969	5.88	0.000	.1198975	.239835
Severe:Treat.@Year1	.1750711	.0533686	3.28	0.001	.0704706	.2796715
Severe:Treat.@Year2	.1679579	.0537818	3.12	0.002	.0625474	.2733683



2. The predicted probability of reporting zero total days of back pain was 0.59 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting zero total days of back pain one year after the sham training was 0.57 (5% lower than baseline).

4. The predicted probability of sham subjects reporting zero total days of back pain two years after the sham training and one year after the treatment training was 0.58 (3% lower than baseline and 2% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting zero total days of back pain one year after the treatment training was 0.60 (1% higher than baseline).
6. The predicted probability of treatment subjects reporting zero total days of back pain two years after the first treatment training and one year after the second treatment training was 0.58 (3% lower than baseline and 2% higher than one year after the second treatment training).

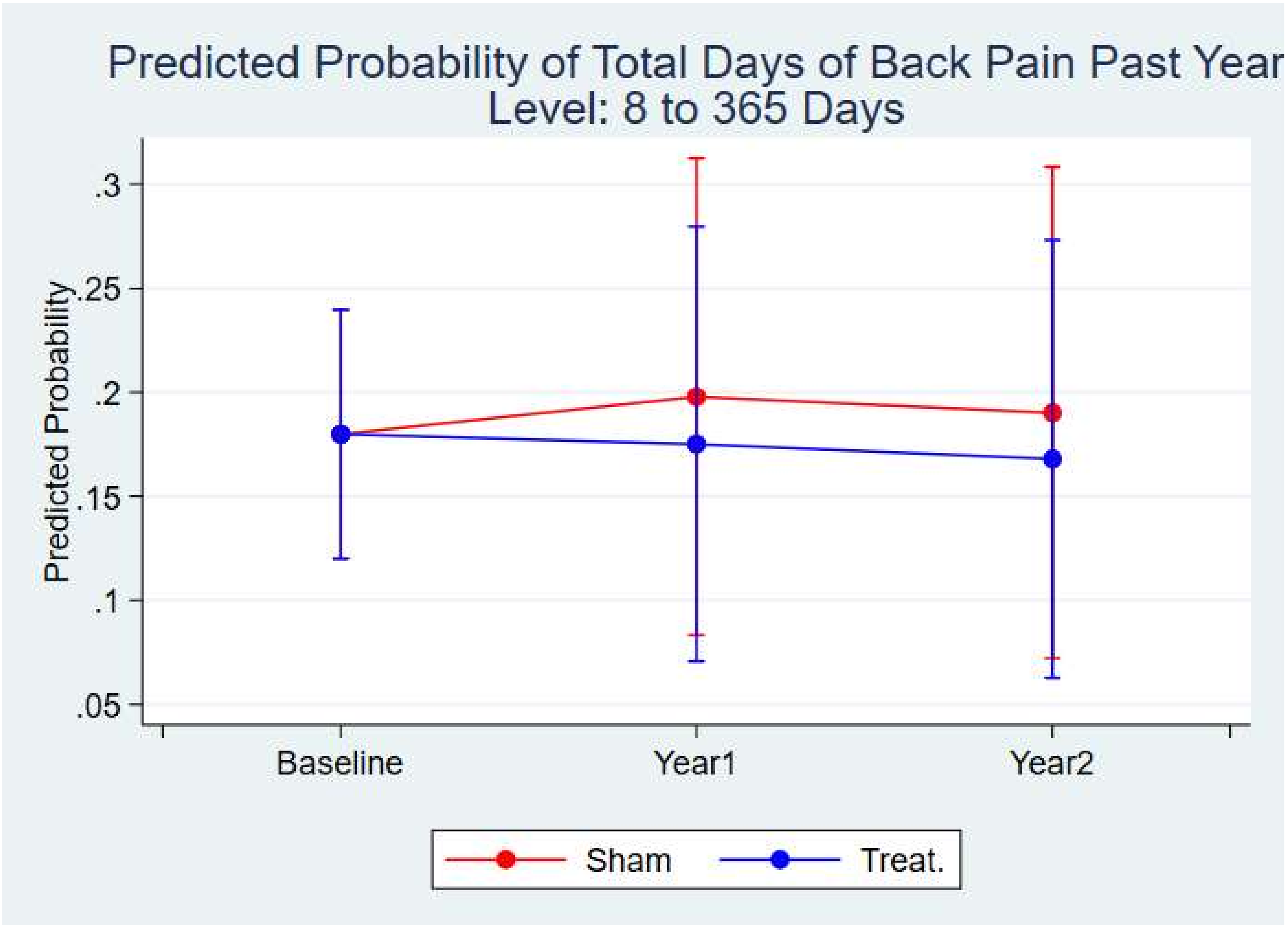


7. The predicted probability of reporting 1-7 total days of back pain was 0.23 at baseline (for both sham and treatment subjects).
8. The predicted probability of sham subjects reporting 1-7 total days of back pain one year after the sham training was 0.24 (4% higher than baseline).

9. The predicted probability of sham subjects reporting 1-7 total days of back pain two years after the sham training and one year after the treatment training was 0.23 (2% higher than baseline and 2% lower than one year after the sham training).

10. The predicted probability of treatment subjects reporting 1-7 total days of back pain one year after the treatment training was 0.22 (1% lower than baseline).

11. The predicted probability of treatment subjects reporting 1-7 total days of back pain two years after the first treatment training and one year after the second treatment training was 0.23 (2% higher than baseline and 2% lower than one year after the second treatment training).



12. The predicted probability of reporting 8-365 total days of back pain was 0.18 at baseline (for both sham and treatment subjects).
13. The predicted probability of sham subjects reporting 8-365 total days of back pain one year after the sham training was 0.20 (10% higher than baseline).

14. The predicted probability of sham subjects reporting 8-365 total days of back pain two years after the sham training and one year after the treatment training was 0.19 (6% higher than baseline and 4% lower than one year after the sham training).
15. The predicted probability of treatment subjects reporting 8-365 total days of back pain one year after the treatment training was 0.18 (3% lower than baseline).
16. The predicted probability of treatment subjects reporting 8-365 total days of back pain two years after the first treatment training and one year after the second treatment training was 0.19 (6% higher than baseline and 4% lower than one year after the second treatment training).

Longest Episode of Back Pain - 3 Levels

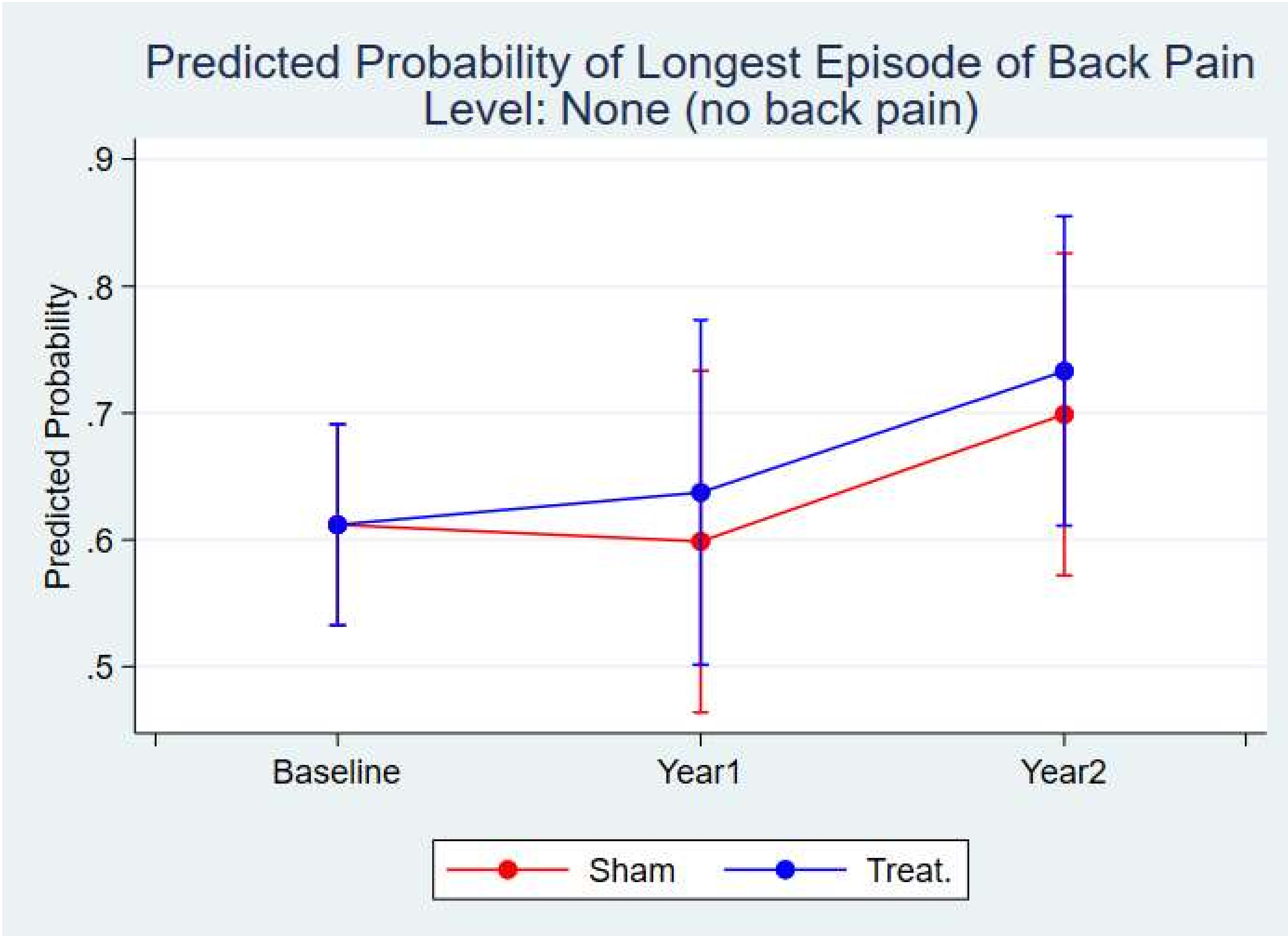
Table 25-29. Mixed Effects Ordered Logistic Regression for Longest Episode of Back Pain (None, <6 Weeks, >6 Weeks)

	Mixed Effects Ordered Logistic Regression				
	OR	Std. error	z	p-value	95% CI
Longest Episode of Back Pain - Three Levels					
Sex=Female	0.454	0.190	-1.89	0.059	[0.200,1.030]
Age (Centered)	1.011	0.022	0.50	0.618	[0.969,1.054]
Number of lifts over 25 pounds/day	1.009	0.019	0.47	0.635	[0.972,1.047]
Tenure	0.979	0.028	-0.74	0.460	[0.927,1.035]
Shift=Night	2.359	1.133	1.79	0.074	[0.920,6.047]
Sleep Time (hrs) on Average per 24hrs	0.789	0.094	-1.99	0.047	[0.625,0.997]
Language (English or Spanish)=Spanish	0.610	0.289	-1.04	0.297	[0.240,1.546]
Have More than UCLA Job=Yes	0.990	0.559	-0.02	0.985	[0.327,2.993]
Stress level during past week=Some	4.021	1.643	3.41	0.001	[1.805,8.957]
Stress level during past week=Most	5.593	3.308	2.91	0.004	[1.755,17.828]
Sham Training (Lifting Technique)=Impact 1yr After 1st Session	0.853	0.378	-0.36	0.719	[0.357,2.034]
Treatment Training (Bending)	0.672	0.165	-1.62	0.106	[0.416,1.088]
Survey=Year1	1.271	0.503	0.61	0.545	[0.585,2.760]
Survey=Year2	1.000	0.000			
/					
cut1	-0.083	0.926			[-1.898,1.731]
cut2	2.272	0.951			[0.409,4.135]
var(_cons[idnum])	1.359	0.857			[0.395,4.678]

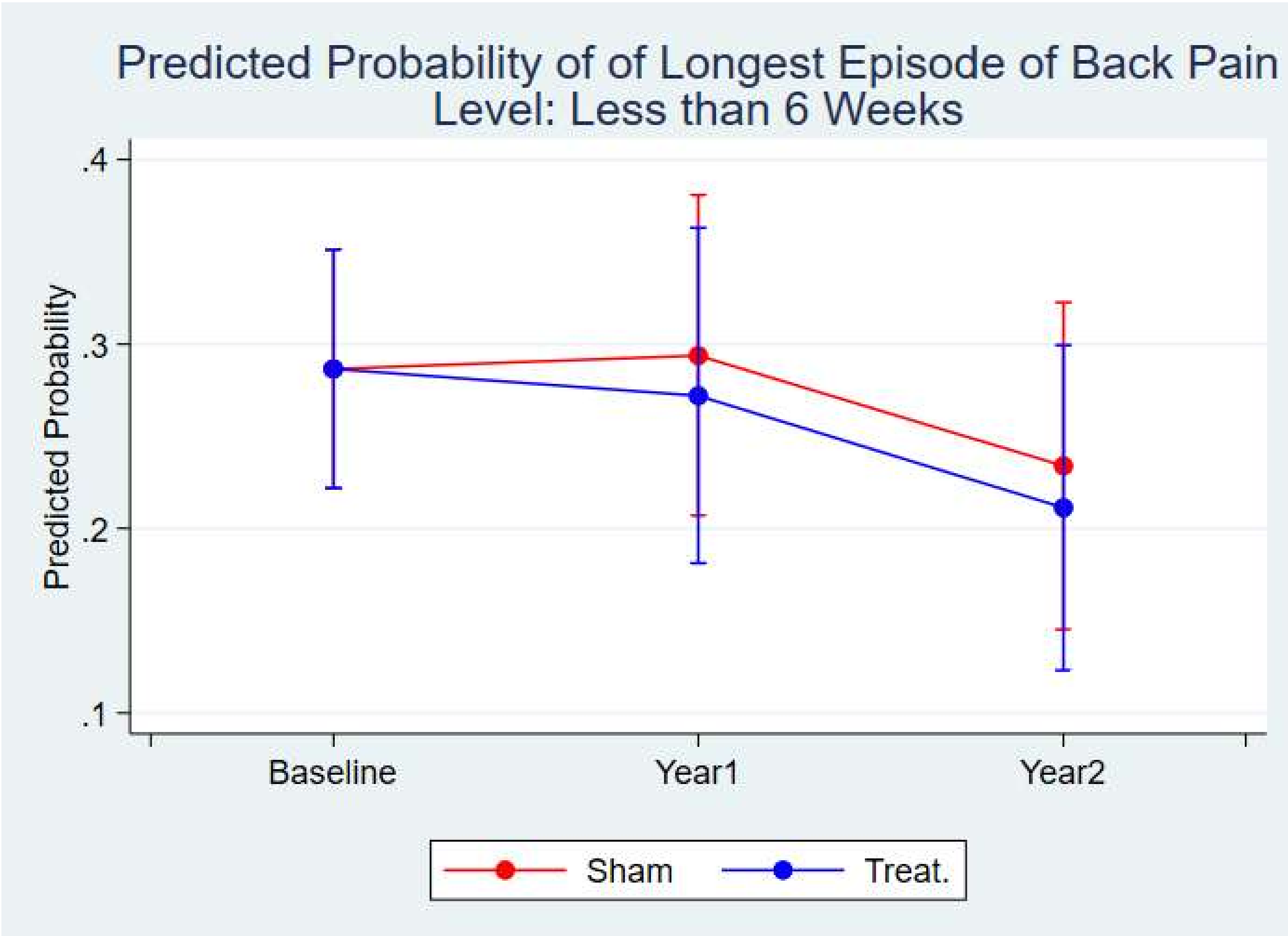
1. Both the sham (lifting) and treatment (bending) training decreased the odds of longest episode of back pain (three levels) (odds ratio, p, & [CI's]: 0.853, 0.719, [0.357,2.034] and 0.672, 0.106, [0.416,1.088], sham and treatment training respectively). This represents 15% decreased odds of reporting longest episode of back pain (three levels) for sham subjects receiving the sham (lifting) training and 33% decreased odds of reporting longest episode of back pain (three levels) for the treatment training (bending) over the course of the study.

Table 25-30. Marginal Predicted Probability of Longest Episode of Back Pain (None, <6 Weeks, >6 Weeks)

	Predict.Prob.	Std. error	z	p-value	95% CI	
None:Sham@Baseline	.6118915	.0404835	15.11	0.000	.5325454	.6912377
None:Sham@Year1	.598744	.0687143	8.71	0.000	.4640665	.7334215
None:Sham@Year2	.6989545	.064841	10.78	0.000	.5718684	.8260406
None:Treat.@Baseline	.6118915	.0404835	15.11	0.000	.5325454	.6912377
None:Treat.@Year1	.6373617	.0693631	9.19	0.000	.5014125	.773311
None:Treat.@Year2	.7330545	.0621942	11.79	0.000	.6111561	.8549528
<6Weeks:Sham@Baseline	.2866012	.0330427	8.67	0.000	.2218387	.3513637
<6Weeks:Sham@Year1	.293836	.044335	6.63	0.000	.2069409	.3807311
<6Weeks:Sham@Year2	.2339184	.0453123	5.16	0.000	.1451079	.3227289
<6Weeks:Treat.@Baseline	.2866012	.0330427	8.67	0.000	.2218387	.3513637
<6Weeks:Treat.@Year1	.2720239	.0463979	5.86	0.000	.1810857	.3629621
<6Weeks:Treat.@Year2	.2112177	.0450536	4.69	0.000	.1229142	.2995211
>6Weeks:Sham@Baseline	.1015072	.0227079	4.47	0.000	.0570005	.146014
>6Weeks:Sham@Year1	.10742	.0352265	3.05	0.002	.0383772	.1764627
>6Weeks:Sham@Year2	.0671271	.0255139	2.63	0.009	.0171208	.1171334
>6Weeks:Treat.@Baseline	.1015072	.0227079	4.47	0.000	.0570005	.146014
>6Weeks:Treat.@Year1	.0906143	.0314898	2.88	0.004	.0288954	.1523333
>6Weeks:Treat.@Year2	.0557278	.0219375	2.54	0.011	.0127312	.0987244

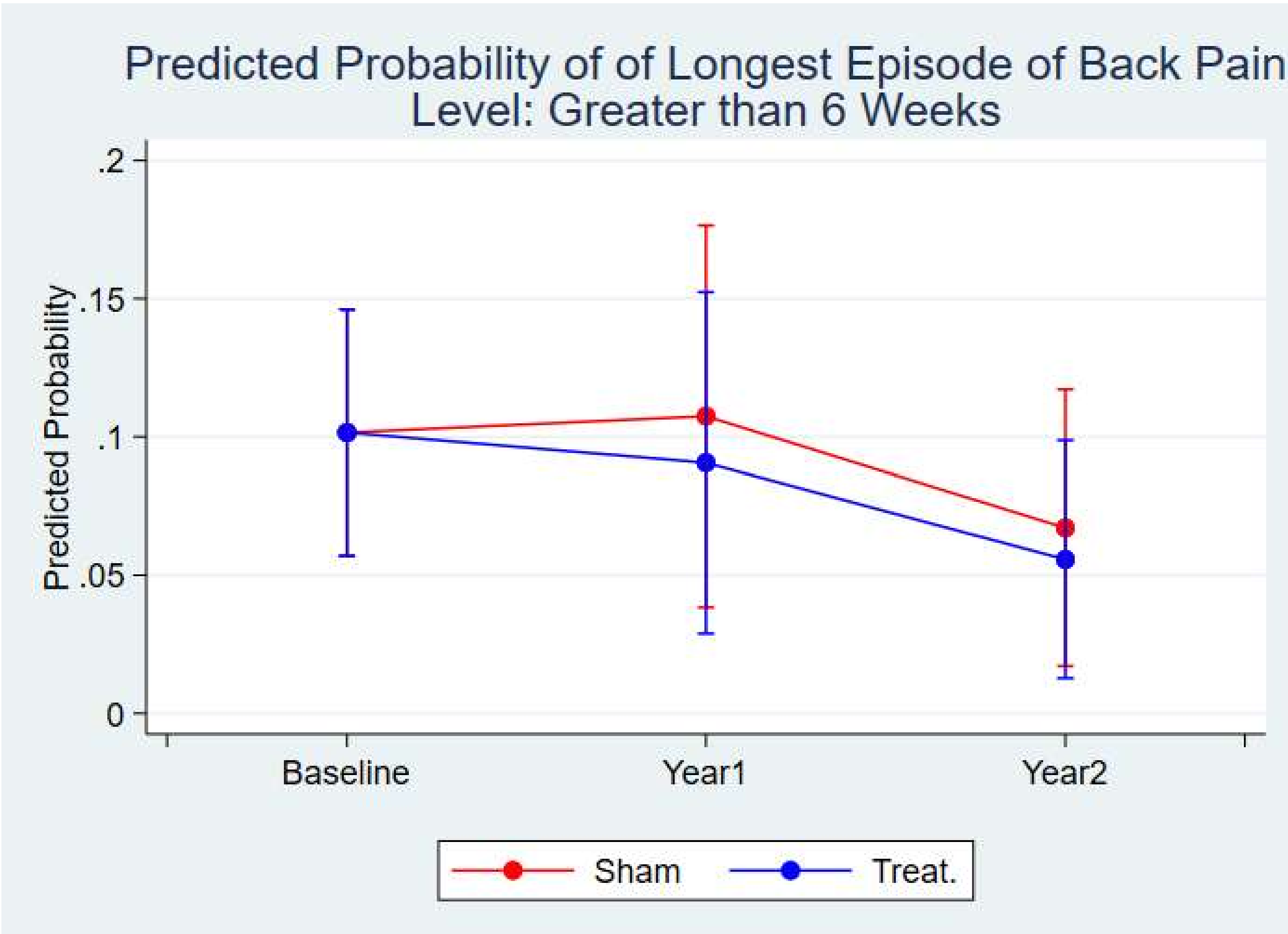


2. The predicted probability of reporting having no back pain was 0.61 at baseline (for both sham and treatment subjects).
3. The predicted probability of sham subjects reporting having no back pain one year after the sham training was 0.60 (2% lower than baseline).
4. The predicted probability of sham subjects reporting having no back pain two years after the sham training and one year after the treatment training was 0.7 (14% higher than baseline and 17% higher than one year after the sham training).
5. The predicted probability of treatment subjects reporting having no back pain one year after the treatment training was 0.64 (4% higher than baseline).
6. The predicted probability of treatment subjects reporting having no back pain two years after the first treatment training and one year after the second treatment training was 0.7 (14% higher than baseline and 17% higher than one year after the second treatment training).



7. The predicted probability of reporting having the longest episode of back pain last less than 6 weeks was 0.29 at baseline (for both sham and treatment subjects).
8. The predicted probability of sham subjects reporting having the longest episode of back pain last less than 6 weeks one year after the sham training was 0.29 (3% higher than baseline).
9. The predicted probability of sham subjects reporting having the longest episode of back pain last less than 6 weeks two years after the sham training and one year after the treatment training was 0.23 (18% lower than baseline and 20% lower than one year after the sham training).
10. The predicted probability of treatment subjects reporting having the longest episode of back pain last less than 6 weeks one year after the treatment training was 0.27 (5% lower than baseline).
11. The predicted probability of treatment subjects reporting having the longest episode of back pain

last less than 6 weeks two years after the first treatment training and one year after the second treatment training was 0.23 (18% lower than baseline and 20% lower than one year after the second treatment training).



12. The predicted probability of reporting having the longest episode of back pain last 6 weeks or more was 0.1 at baseline (for both sham and treatment subjects).
13. The predicted probability of sham subjects reporting having the longest episode of back pain last 6 weeks or more one year after the sham training was 0.11 (6% higher than baseline).
14. The predicted probability of sham subjects reporting having the longest episode of back pain last 6 weeks or more two years after the sham training and one year after the treatment training was 0.07 (34% lower than baseline and 38% lower than one year after the sham training).
15. The predicted probability of treatment subjects reporting having the longest episode of back pain last 6 weeks or more one year after the treatment training was 0.09 (11% lower than baseline).

16. The predicted probability of treatment subjects reporting having the longest episode of back pain last 6 weeks or more two years after the first treatment training and one year after the second treatment training was 0.07 (34% lower than baseline and 38% lower than one year after the second treatment training).

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