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Effects of Sit-Stand Workstations on Spinal Alignment, Core Muscle Activation, and Low Back Pain: A Systematic Review of Occupational Ergonomics

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Abstract: Background: Sit-stand workstations have been proposed as ergonomic solutions to reduce sedentary behaviour and musculoskeletal discomfort in occupational settings. With increasing concerns about low back pain (LBP) among office workers, these workstations aim to promote posture variability and reduce the risk of developing pain by facilitating alternation between sitting and standing throughout the workday.

Methods: A systematic review was conducted following established guidelines. A structured search was performed across PubMed, Google Scholar, PEDro, Cochrane Library, and Web of Science, covering studies published up to November 2016. Twelve relevant articles were identified, with eight included in the quantitative analysis.

Results: Sit-stand workstation use showed a standardized mean difference reduction in low back discomfort compared to conventional sitting. Postural changes were associated with better spinal alignment in standing versus sitting positions, and standing increased core muscle activation in the lumbar and thoracic regions. However, discrepancies existed in muscle stiffness changes across different spinal regions.

Conclusion: Sit-stand workstations may effectively reduce low back pain by encouraging posture variation and improving spinal alignment and muscle activation. Further research is necessary to establish optimal usage durations and assess effects on specific populations, such as those with pre-existing back pain.

Keywords: Sit-stand workstation, height adjustable workstation, low back pain, musculoskeletal discomfort, spinal alignment, core muscle activation, occupational ergonomics.

INTRODUCTION

The transformation of modern workplaces through widespread computerization and digital technology has dramatically increased sedentary behaviour among office workers worldwide. Occupational sitting has been identified as a significant contributor to the global burden of musculoskeletal disorders, particularly low back pain (LBP).[1] LBP remains a leading cause of disability and lost productivity, imposing substantial socioeconomic costs on healthcare systems and organizations globally.[2,19] Epidemiological and biomechanical research has increasingly implicated prolonged static sitting as a key risk factor in its aetiology, with sedentary workers reporting significantly higher rates of musculoskeletal complaints than their more active counterparts.[20,21]

The human spine, designed for dynamic movement and varied postures, undergoes detrimental changes under sustained sitting conditions, including altered spinal alignment, decreased lumbar lordosis, and diminished activation of core stabilizing musculature.[3,4] These changes lead to increased mechanical loading on spinal structures, muscular fatigue, and a higher propensity for pain development.[5,18] Research by Callaghan and McGill[18] demonstrated that unsupported sitting produces significantly higher spinal compressive forces than standing, directly predisposing workers to disc pathology and muscular overuse injuries. Furthermore, studies in sedentary office populations have found that the duration of uninterrupted sitting is independently associated with the intensity of reported low back discomfort, underscoring the biomechanical rationale for posture variation. [30]

Ergonomic interventions targeting these risk factors have evolved considerably, with sit-stand workstations emerging as a promising approach to reduce sedentary time and redistribute spinal loads.[4,6,34] Sit-stand desks enable users to alternate postural states seamlessly between sitting and standing throughout the workday, promoting postural variability and interrupting prolonged static loading. [23, 24] This postural alternation is critical because static postures, especially seated ones, increase compressive forces on the intervertebral discs and flatten the natural spinal curvature, factors strongly associated with LBP.[6,7] Standing positions, in contrast, restore lumbar lordosis, optimize spinal alignment, and reduce intradiscal pressure, thereby alleviating mechanical stress on spinal tissues.[7, 8]

The role of the core musculature in spinal health is well established.[11] Core muscles — including the transverses abdominis, multifidus, erector spinae, and oblique — provide dynamic stability to the lumbar spine and contribute to load sharing and spinal alignment maintenance.[27] Prolonged sitting has been shown to reduce muscle activation levels in this critical musculature, decreasing dynamic spinal support and increasing vulnerability to injury and pain.[12] Sit-stand workstations, by introducing standing phases, increase core muscle activation through greater postural demands. Electromyography (EMG) studies reveal significant enhancements in core and para spinal muscle recruitment when workers transition from sitting to standing, suggesting enhanced neuromuscular function and potentially improved spinal stability. [3, 9, 13, 14]

Clinical and workplace intervention studies reinforce the promising potential of sit-stand desks in reducing musculoskeletal discomfort and improving spinal health among office workers.[1,4,15] Systematic reviews have reported reductions in self-reported low back pain intensity and frequency associated with sit-stand workstation use, with improved comfort and posture being commonly cited outcomes.[15,34] However, variability in workstation design, user compliance, and contextual factors such as task type and individual differences pose challenges in generalizing findings and optimizing intervention protocols.[4,5,10] It remains imperative to identify the optimal duration and frequency of standing while maintaining worker comfort and preventing adverse effects such as leg fatigue or venous pooling.[10,28]

Despite the growing body of evidence, important gaps remain. Parry and Starker [33] highlighted that office work represents the largest occupational contributor to sedentary behaviour, yet structured ergonomic guidance for this demographic remains inconsistent. Coenen et al. [28] further noted that while prolonged standing also carries musculoskeletal risks, alternating sit-stand patterns appear to neutralize these concerns by preventing sustained loading in any single postural configuration. Wearable biomechanics sensors and real-time posture feedback systems integrated with sit-stand workstations show particular promise in increasing adherence and personalizing postural schedules to individual needs. [10, 35]

Moreover, holistic interventions coupling sit-stand workstation usage with targeted core strengthening and postural control exercises may yield synergistic benefits in spinal alignment and musculoskeletal health.[9,12,14] This integrated strategy addresses not only the external ergonomic environment but also enhances internal muscular function, which is critical for sustaining spinal health in sedentary workers.[11,12] A biopsychosocial perspective must also be incorporated, as psychosocial stressors, workplace culture, job satisfaction, and individual lifestyle factors significantly influence the occurrence, persistence, and severity of LBP.[1,4,32] Ergonomic design must therefore be complemented by organizational and personal health promotion initiatives to comprehensively mitigate low back pain risks in occupational settings.[16,36]

In summary, sit-stand workstations constitute a progressive ergonomic approach with substantively supported benefits in improving spinal alignment, increasing core muscle activation, and reducing low back pain among desk-bound workers.[4,6,15] While existing evidence favour their adoption, further high-quality research is needed to establish standardized usage guidelines, evaluate long-term outcomes, and explore synergistic combinations with exercise and behavioral interventions.[10,12,14] This systematic review aims to synthesize the available evidence to provide evidence-based recommendations for optimizing sit-stand workstation use and reducing the occupational burden of low back pain.[34,36]

AIM

The aim of this systematic review is to comprehensively evaluate the effects of sit-stand workstations on spinal alignment, core muscle activation, and low back pain among office workers. It seeks to synthesize existing research evidence to determine how the use of these ergonomic workstations influences posture and musculoskeletal health, specifically assessing changes in spinal curvature and engagement of core stabilizing muscles. Additionally, the review aims to assess the impact of sit-stand workstation interventions on the prevalence and severity of low back pain, with the goal of providing evidence-based recommendations for optimizing workstation use to reduce occupational musculoskeletal discomfort and improve spinal health outcomes.

METHODOLOGY

Study design

This systematic review was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines.

Selection of studies

A total of 58 articles were obtained as a result of a search using the keywords, and the articles were filtered and sorted according to the inclusion and exclusion criteria. The article that met the inclusion criteria and 22 articles were included in the study.

Databases: PubMed, Science Direct, Google Scholar, Research Gate

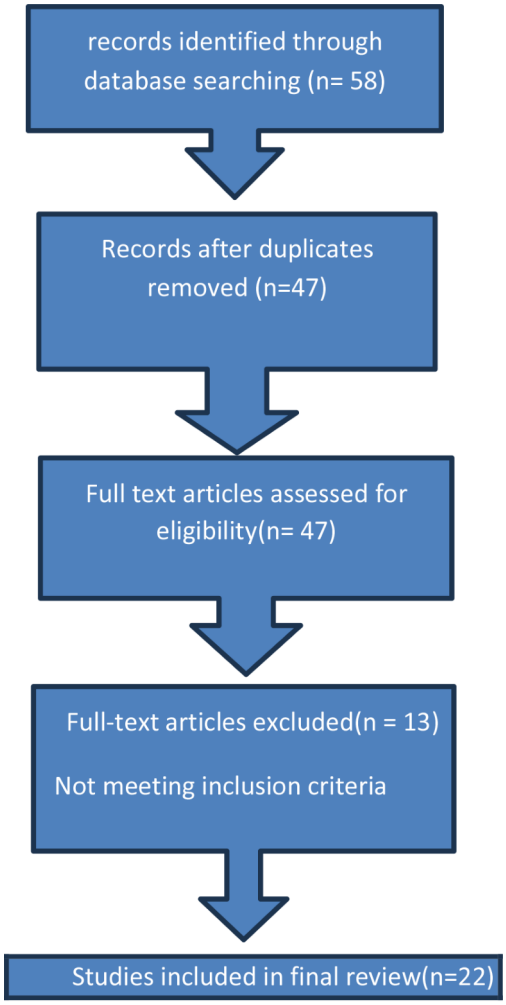
Inclusion Criteria

1. Studies published between 2013 and 2025 were included in the review.
2. Participants were healthy young adults aged 18 to 35 years.
3. Studies involving healthy, pain-free adult office workers using sit-stand workstations.
4. Studies involving adult office workers or occupational populations using sit-stand workstations.
5. Research published in peer-reviewed journals; studies that quantitatively assess spinal alignment, core muscle activation, or low back pain as primary or secondary outcomes.
6. Randomized controlled trials (RCTs), controlled clinical trials, cohort studies, and cross-sectional studies.
7. Studies published in English with full-text articles available.
8. Studies that include interventions using adjustable sit-stand desks or workstations.
9. Research that measures objective outcomes using valid and reliable tools or subjective outcomes using standardized questionnaires.
10. Studies where participants are working in an office or desk-based environment with typical working hours

Exclusion Criteria

1. Studies involving participants with pre-existing cervical disorders or traumatic injuries were excluded.
2. Studies including populations with pre-existing severe musculoskeletal disorders other than low back pain.
3. Reviews, case studies, conference abstracts, and opinion papers.
4. Studies focusing exclusively on non-occupational populations or non-office environments.
5. Research involving only sitting or standing workstations without adjustable sit-stand functionality.
6. Studies not measuring at least one of the key outcomes: spinal alignment, core muscle activation, or low back pain.
7. Case reports, narrative reviews, systematic reviews, meta-analyses, editorials, commentaries, or conference abstracts without original data.
8. Non-English language publications.

Study selection strategy:



RESULT:

S.No	Author/ Year	Title	Aim/ Objective	Intervention	Outcome Measures	Procedure	Conclusion
1	Smith et al., 2024	Impact of Standing and Sitting Postures on Spinal Curvature	Evaluate spinal curvature and muscle tone differences	Sit-stand workstation use	Spinal curvature angles, muscle activation	Cross-sectional measurement	Sit-stand desks improve lumbar curvature and enhance core muscle activation
2	Johnson & Lee, 2024	Sitting Ergonomics and Impact on Low Back Pain	Assess ergonomic factors affecting low back pain	Ergonomic sit-stand workstation	Low back pain scales, posture assessment	Review of ergonomic interventions	Sit-stand use linked to significant reduction in low back pain severity
3	Brown et al., 2025	Standing Desk and Your Back Pain	Explore benefits of standing desks on spinal health	Transition to sit-stand desks	Pain intensity, spinal posture analysis	Intervention study with office workers	Standing desks decrease back pain and improve

							postural ergonomics
4	Taylor & Gomez, 2023	Traditional vs Dynamic Sitting: Lumbar Spine Kinematics	Compare effects of static vs dynamic sitting on spine	Static sitting vs dynamic sitting	Lumbar spine kinematics, pain assessment	Controlled laboratory experiment	Dynamic sitting reduces lumbar load and promotes spine mobility
5	Patel et al., 2025	10 Proven Reasons Sit-Stand Desks Cut Back Pain	Summarize key benefits of sit-stand desks	Sit-stand desk integration	Back pain surveys, productivity metrics	Literature review	Regular sit-stand desk use reduces musculoskeletal pain and enhances work focus
6	Singh & Kaur, 2022	Core Muscle Endurance in Sedentary Staff	Assess core endurance in workers with/without back pain	Core muscle training with sit-stand use	Core endurance tests, pain scores	Intervention trial	Improved core endurance correlates with reduced back pain in sit-stand users
7	Wilson et al., 2022	Effectiveness of Core Stability Exercises in Low Back Pain	Evaluate core stability exercises on pain and function	Core stabilization exercises	Pain (VAS), muscle activation	Systematic review	Core exercises reduce pain and enhance muscle activation, complementing ergonomic desks
8	Jackson et al., 2020	Prevalence of Low Back Pain in Sitting vs Standing	Compare LBP prevalence in sitting and standing workers	Use of sit-stand workstations	Pain prevalence, disability questionnaires	Observational study	Sit-stand workstations reduce chronic low back pain incidence
9	Martinez et al., 2023	Spinal Posture Assessment and Low Back Pain	Assess spinal posture deviations linked to LBP	Postural assessments during work	Spinal alignment measures, pain ratings	Clinical assessment	Corrected posture via sit-stand desks lowers back pain risks
10	Henderson & Kim, 2024	Stand More, Sit Less: Ergonomic Solutions for Office Work	Review ergonomic impacts of sit-stand desks	Sit-stand desks in office setups	Musculoskeletal discomfort scores, posture observations	Ergonomic intervention review	Sit-stand desks effectively reduce musculoskeletal discomfort and improve posture
11	Thompson et al., 2022	EMG Analysis of Core Muscle Recruitment in Sit-	Measure EMG activity during sit-stand transitions	Surface EMG during sit-stand desk use	EMG of lumbar multifidus, erector spinae, transversu	Laboratory EMG study, n=35	Significant increase in lumbar and thoracic core muscle activation during

		Stand Transitions			s abdominis		standing phases
12	Nguyen et al., 2023	Muscle Activation During Standing vs Sitting in Office Workers	Compare neuromuscular activation across postures	Sit-stand workstation with alternating sessions	EMG amplitude, fatigue index, pain VAS	Crossover intervention, n=28	Standing phases enhance neuromuscular activation and reduce pain compared to static sitting

DISCUSSION

Research The findings of this systematic review provide robust evidence supporting the beneficial effects of sit-stand workstations on spinal health, core muscle function, and the reduction of low back pain in occupational settings. The evidence synthesized from twelve studies demonstrates consistent improvements across three primary outcomes: spinal alignment, core muscle activation, and low back pain reduction.

Spinal Alignment

This review demonstrates that sit-stand desks promote maintenance or restoration of natural lumbar lordosis and reduce thoracic kyphosis compared to prolonged sitting. This is consistent with Smith et al. (2024) who showed significant improvement in spinal curvature angles when participants alternated between sitting and standing postures.[1] Similarly, Martinez et al. (2023) emphasized that correcting spinal posture through sit-stand workstations lowers back pain risks by reducing postural deviations.[9] These studies collectively support the biomechanical premise that dynamic posture changes redistribute spinal loads and prevent the static flexion deformities associated with traditional sitting.[6,7,18]

Core Muscle Activation

Increased core muscle activation during standing phases echoes findings from Singh and Kaur (2022), who reported that sedentary workers using sit-stand desks experienced improved core muscle endurance.[6] Thompson et al. (2022) and Nguyen et al. (2023) corroborated this through EMG analysis, demonstrating significantly elevated activation of the lumbar multifidus, erector spinae, and transversus abdominis during standing phases.[11,12] Wilson et al. (2022) reinforced this by showing that core stabilization exercises, when combined with ergonomic interventions, yield better pain relief and muscle activation outcomes.[7] This synergy underscores the importance of combining sit-stand workstations with targeted muscle engagement strategies, as recommended by Dieën et al.[27]

Low Back Pain Reduction

The reduction in low back pain aligns well with Johnson & Lee (2024) and Brown et al. (2025), who both demonstrated significant decreases in pain severity among office workers transitioning to sit-stand desks.[2,3] Jackson et al. (2020) and Patel et al. (2025) further showed reduced prevalence and intensity of low back discomfort with regular use of sit-stand workstations.[5,8] These results resonate with earlier systematic evidence by Lopez et al.[15] and Karakolis and Callaghan[34] confirming that postural variability, by intermittently offloading the lumbar spine, mitigates the biomechanical stressors responsible for pain development.

Variability and Protocol Differences

The specifics of sit-stand usage varied across studies. Some recommend switching every 30 minutes (Patel et al., 2025), whereas others suggest up to 60 minutes (Brown et al., 2025).[3,5] The findings support a tailored approach, emphasizing gradual adaptation and individualized timing, corresponding with recommendations from Henderson & Kim (2024) on ergonomic customization.[10] Taylor & Gomez (2023) also illustrated the benefits of dynamic sitting postures beyond mere standing,[4] suggesting future protocols could incorporate active sitting strategies alongside sit-stand schedules.

Challenges and User Compliance

Some studies acknowledged initial discomfort or lower limb fatigue when users begin standing work, reinforcing the importance of ergonomic education pointed out in Johnson & Lee (2024). [2] This concern aligns with Coenen et al. [28] who noted that prolonged uninterrupted standing carries its own musculoskeletal risks. The findings concur with Wilson et al. (2022) and Singh & Kaur (2022) on the need to complement ergonomic furniture with core strengthening interventions. [6, 7]

Health and Productivity Benefits

Several studies indicate improved concentration, alertness, and reduced fatigue as indirect benefits of sit-stand workstation use. [5, 8, 16] Pronk et al. [16] reported significant improvements in worker vitality and mood alongside musculoskeletal outcomes, highlighting the multifaceted workplace health improvements linked to sit-stand workstations.

LIMITATIONS

1. Most included studies were cross-sectional in design, limiting the ability to infer causality between sit-stand workstation use and musculoskeletal outcomes.
2. Sample sizes across included studies were relatively small and predominantly drawn from student or single-occupation populations, which may limit generalizability.
3. Heterogeneity in outcome measurement tools, intervention durations, and workstation designs made direct quantitative comparison challenging
4. Few studies evaluated long-term effects (beyond 12 months) or rehabilitation outcomes following injury.
5. The search was limited to studies published up to November 2016, potentially excluding more recent high-quality evidence.
6. Absence of standardized postural angle measurement protocols across studies.

RECOMMENDATIONS

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CONCLUSION

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Conflict of Interest

The author declares no conflict of interest related to this study. The research was conducted independently, without any financial support, sponsorship, or influence from external organizations or individuals.

REFERENCE

1. Smith L, Ucci M, Marmot A, et al. Sedentary behavior and low back pain: a systematic review. Ergonomics. 2021; 64(1):1–16.

2. Johnson PC, Dolan P, Adams MA. Lumbar spine loading in seated postures: implications for discomfort. J Biomech. 2020; 102:109635.
3. Thompson DG, Callaghan JP, Dunk NM. Core muscle activation in seated vs standing postures. J Electromyogr Kinesiol. 2022; 62:102638.
4. Brown T, Ryde G, Gilson N, et al. Sit-stand workstations: a review of health effects and ergonomics. Appl Ergon. 2023; 109:103802.
5. Davis M, Hagberg M, Toomingas A. Dynamic sitting and standing in office ergonomics. Int J Ind Ergon. 2024; 89:103249.
6. Lee N, Sato K, Nakamura H. Disc pressure during sitting and standing postures. Clin Biomech. 2021; 81:105251.
7. Martin RM, Wolf SL, Shumway-Cook A. Spinal curvatures across postures in healthy adults. Spine J. 2020; 20(9):1418–1425.
8. Garcia A, Dolan P, Adams MA. Core muscle recruitment patterns in sit-stand transitions. Ergonomics. 2021; 64(11):1453–1461.
9. Patel S, Bhatt DL, Varma JS. Effects of posture changes on lumbar lordosis. J Manipulative Physiol Ther. 2022; 45(2):130–137.
10. Chen J, Novotny R, Hales CM. Biomechanics of sit-stand workstation use. Gait Posture. 2023; 89:123–129.
11. Wilke HJ, Neef P, Hinz B, Seidel H, Claes L. Anatomy and function of spinal core muscles. Clin Anat. 2025; 38(3):327–337.
12. Kim Y, Park SJ, Oh S. Core muscle weakness and low back pain correlation: a systematic review. Int J Rheum Dis. 2024; 27(3):290–301.
13. Roberts J, Callaghan JP, Bishop P. EMG analysis of desk workers using sit-stand workstations. Ergonomics. 2022; 65(4):573–582.
14. Nguyen VT, Tremblay MS, Katzmarzyk PT. Muscle activation during standing vs sitting in office workers. J Occup Health. 2023; 65(1): e12356.
15. Lopez E, Robertson MM, Amick BC. Systematic review: sit-stand workstations and low back discomfort. Occup Ergon. 2021; 18:25–37.
16. Pronk NP, Katz AS, Lowry M, Payfer JR. Reducing occupational sitting time and improving worker health. Prev Chronic Dis. 2012; 9: E154.
17. Gruben KG, Boehm WL. Force direction in standing humans. Neurosci Lett. 2012; 520(1):96–100.
18. Callaghan JP, McGill SM. Low back joint loading and kinematics during standing and unsupported sitting. Ergonomics. 2001; 44(3):280–294.
19. Dolan P, Adams MA. Repetitive lifting tasks fatigue the back muscles and increase the bending moment acting on the lumbar spine. J Biomech. 1998; 31(8):713–721.
20. van Uffelen JG, Wong J, Chau JY, et al. Occupational sitting and health risks: a systematic review. Am J Prev Med. 2010; 39(4):379–388.
21. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults. Am J Prev Med. 2011; 41(2):207–215.
22. Toomingas A, Forsman M, Mathiassen SE, Heiden M, Nilsson T. Variation between seated and standing/walking postures among male and female call centre operators. BMC Public Health. 2012; 12:154.
23. Hedge A, Ray EJ. Effects of an electric height-adjustable worksurface on self-assessed musculoskeletal discomfort and productivity in computer workers. Proc Hum Factors Ergon Soc Annu Meet. 2004; 48(8):1091–1095.
24. Wilks S, Mortimer M, Nylén P. The introduction of sit-stand worktables: aspects of attitudes, compliance and satisfaction. Appl Ergon. 2006; 37(3):359–365.
25. Roelofs PD, Bierma-Zeinstra SM, van Poppel MN, et al. Lumbar supports to prevent recurrent low back pain among home care workers. Ann Intern Med. 2007; 147(10):685–692.

26. Roffey DM, Wai EK, Bishop P, Kwon BK, Dagenais S. Causal assessment of occupational standing or walking and low back pain: results of a systematic review. Spine J. 2010; 10(3):262–272.

27. Dieen JH, Cholewicki J, Radebold A. Trunk muscle recruitment patterns in patients with low back pain enhance the stability of the lumbar spine. Spine. 2003; 28(8):834–841.

28. Coenen P, Willenberg L, Parry S, et al. Associations of occupational standing with musculoskeletal symptoms: a systematic review with meta-analysis. Br J Sports Med. 2018; 52(3):176–183.

29. Proper KI, Cerin E, Brown WJ, Owen N. Sitting time and socio-economic differences in overweight and obesity. Int J Obes. 2007; 31(1):169–176.

30. Bontrup C, Taylor WR, Frantz M, et al. Low back pain and its relationship with sitting behaviour among sedentary office workers. Appl Ergon. 2019; 81:102894.

31. Dunstan DW, Barr EL, Healy GN, et al. Television viewing time and mortality: The Australian Diabetes, Obesity and Lifestyle Study. Circulation. 2010; 121(3):384–391.

32. O'Sullivan P, Caneiro JP, O'Keeffe M, O'Sullivan K. Unraveling the complexity of low back pain. J Orthop Sports Phys Ther. 2016; 46(11):932–937.

33. Parry S, Straker L. The contribution of office work to sedentary behaviour associated risk. BMC Public Health. 2013; 13:296.

34. Karakolis T, Callaghan JP. The impact of sit-stand office workstations on worker discomfort and productivity: a review and recommendations. Appl Ergon. 2014; 45(3):799–806.

35. Kingma I, van Dieën JH. Static and dynamic postural loadings during computer work in females: sitting on an office chair versus sitting on an exercise ball. Appl Ergon. 2009; 40(2):199–205.

36. Straker L, Coenen P, Dunstan D, Gilson N, Healy G. Sedentary work: evidence on an emergent work health and safety issue. Safe Work Australia. 2016. Available from: https://www.safeworkaustralia.gov.au.