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Critical Issues and Trends: Physical Activity

Unstable Sitting in the Workplace—Are There Physical Activity Benefits?

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Abstract

The increasingly popular practice of using a stability ball (exercise/fitness ball) as a sitting surface runs counter to conventional human factors/ergonomics guidelines for seated workspace design. Employees sitting on stability balls in an office environment present safety risks that might be justifiable if the practice has a definitive benefit to the promotion of health. However, the published studies and best evidence to date call into question even the theoretical basis for this practice and do not suggest significant health benefits. First, biomechanical studies do not confirm the intended trunk muscle activation. Second, energy expenditure studies show a small (if any) increase in metabolic demand that is unlikely to be effective in combating sedentary work risk factors. Until studies demonstrate more conclusive benefits, the practice of stability ball sitting should be viewed skeptically as a general workplace recommendation in the interest of health or wellness.

In the last five decades the number of U.S. occupations requiring physical activity of at least moderate intensity has declined from an estimated 50% to less than 20%.[1] This parallels the increase in sedentary jobs and corroborates an unpublished, but widely publicized, office furniture industry survey estimating that 86% of U.S. workers now do mostly seated work. Over the same five-decade span the field of work physiology, which classically sought to identify excessive physiologic demands of heavy labor, has been almost supplanted by the discipline of sedentary physiology, which addresses the lack of physiologic demands in the contemporary workplace. Trends in general lifestyle and occupational sedentariness have been well described in the obesity prevention and health promotion communities, and concerns about obesity and associated health outcomes have permeated the growing industry of workplace wellness. Recognition of the need for increased population physical activity, and the inability to attain this outside of the workday, has resulted in a number of what Tudor-Locke et al.[2] refer to as "office environmental countermeasures to stoic occupational sedentarism…."

This commentary addresses one specific practice and emerging trend to counteract the office environmental sedentariness experienced by the majority of working Americans—that of unstable sitting (or "active sitting" as it is sometimes counterintuitively referred to). The purpose of this commentary is to broadly summarize studies that have considered health aspects of unstable sitting and to encourage an objective use of the evidence in making decisions about the use of such equipment for sitting.

The traditionally accepted guidance for seated workplace design prioritizes reducing trunk muscle activation and corresponding intervertebral disc pressure in the seated worker. This objective has been a hallmark in introductory ergonomics textbooks and is rooted in human factors design standards.[3] The chair backrest and lumbar support are the design features that achieve a reduction in spinal stress. Use of a backrest support surface for the lumbar spine reduces activation of trunk muscles and aligns the spine in a more optimal lordosis, or "S-shaped," posture.[4] The reduction in trunk muscle activation and more optimal lumbar lordosis thus reduces loads on the intervertebral discs.[5] Early experiments confirmed this with direct measurement of intervertebral disc pressure.[5]

Popular computer workstation and office seating trends appear to be challenging, if not outright rejecting, established guidance in regard to the chair backrest and lumbar support. A trend among health/fitness practitioners and/or those giving wellness advice is to induce a challenge to the trunk musculature in the seated posture by substitution of the traditional chair with a free-standing stability ball (i.e., Swiss ball, exercise ball, gym ball, therapy ball, balance ball, isometric ball, etc.). The unstable (stability ball) seating practice is predicated on deliberately inducing a trunk muscle (or "core activation") challenge to create an exercise stimulus and a beneficial physiological response for the

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individual. It is difficult to quantify how pervasive this practice has become in the workplace. The Swiss ball has been used in therapeutic exercise since the 1960s, and therapists have used these balls effectively as a platform from which various exercise stimuli are created with external weight, manual resistance, or body weight targeting activation of specific muscle groups. However, the rapid rise in popularity of these balls for general fitness use, and now as chairs, appears to be more recent. Examples and imagery of stability ball seating configurations (in office, home, and school environments) are widespread on the Internet and in mainstream health news and advice articles.[6–9] A recent popular health/fitness magazine article is representative of the way this information is often presented, stating that "swapping out your regular chair for a stability ball is a very sneaky way to strengthen your core and lower back muscles, improve your posture, and even burn a few extra calories during your workday." These suggestions may be well intentioned—motivated by therapeutic uses of these balls, increasing popularity of "core activation" exercises among fitness professionals, and innovative attempts to combat sedentarism in the workday. However, there appears to be minimal evidence to justify the adoption of stability ball seating as an alternative to traditionally accepted seating principles.

First, use of unstable exercise balls does not appear to contribute to increased trunk muscle activation as a beneficial exercise stimulus. A study conducted by spine biomechanics researchers at the University of Waterloo found no greater trunk muscle activity when users sat on a stability ball as compared to a stable stool without a backrest.[10] This result raises doubts about the fundamental premise for the practice and suggests that the unstable seating configuration is no different than a merely unsupportive surface—that is, a rigid but stable stool. If no difference in trunk muscle activity exists between the stable stool and unstable exercise ball, and the goal is to induce trunk muscle challenge, the stool would seem to be a preferable alternative from the standpoint of safety. A recent review[11] of seven studies reported that five of these demonstrated no increase in trunk muscle activation with dynamic sitting. One of the two studies that reported an increase in trunk muscle activation found an increase in only one of eight muscles measured.[12] The second of the two studies reported a concurrent increase in spinal shrinkage.[13] This effect is opposite to the expected benefit of "active sitting"—which is that increased spine dynamics would improve fluid transport through the intervertebral disc and reduce spinal shrinkage.[13]

Second, contrary to interpretations such as those promoted in the popular literature, a recent review[2] concluded that the additional energy expenditure (EE) associated with dynamic sitting on a stability ball, beyond that of a standard stable chair, is minimal. A study by Beers et al.[14] showed that additional EE with stability ball sitting was only 4.1 kcal/h higher than that of traditional chair sitting—translating to a mere 33 kcal per 8-hour workday. This seems to be a trivial difference in cumulative EE in contrast to other evidence-based exercise modalities. A more recent pilot study[15] of 13 sedentary adults reported no statistical difference in EE between chair sitting and stability ball sitting.

Third, the safety considerations with stability ball seating need to be considered. Although no published surveys on prevalence of injury could be found, anecdotal reports of loss of balance and falls from stability balls have arisen in Web forums of ergonomics professionals. It is worth noting that the applicable American National Standards Institute/Human Factors and Ergonomics Society standard for computer workstation seating human factors addresses the concern of seating stability: "Workstation furniture shall . . . [b]e structurally rigid and stable under typical usage conditions. . ." and, additionally, "Unstable work surfaces or chairs also may tip over or collapse if used to support the user during changes in posture. . ."[3]

The potential for falls when using stability/exercise balls as workplace seating is not in itself sufficient to reject the practice. All beneficial forms of exercise have some inherent risk. The decision to adopt stability ball seating practice should be influenced by broader risk/benefit considerations. However, a convincing case must be made for any health benefits before the recognized risks can be deemed acceptable.

The traditional practice of workplace ergonomics has few examples of designing the work process and work environment to increase physical demands and or musculoskeletal loads. On the contrary, workplace ergonomic practices have been based on the principle of reducing physiologic and biomechanical loads on the worker. This fundamental principle may change if obesity risk factors (namely sedentarism) cannot be adequately addressed outside of the workplace and during nonwork hours. However, practices that introduce an exercise stimulus during seated work should be based on sound evidence. Trends with exercise balls in the general fitness industry, via their novelty and popularity in fitness programs and their origins in physiotherapeutic exercise, may be unduly influencing suggestions to use these devices for workplace seating. The absence of more convincing evidence raises questions as to whether such a crossover from the exercise/fitness modality is prudent. The current body of evidence appears to be insufficient to conclude that unstable (stability ball) sitting is an effective practice towards achieving a beneficial physiologic response during seated work in an office environment. Nor, to the authors' knowledge, have any guidelines been developed for programming an effective and safe exercise dose for unstable seating based on individual conditioning level, consideration of job demands, or other work environment factors. A recommendation for added exercise stimulus to an employee in their work context should give consideration to a well-programmed and evidence-based exercise modality.

In summary, the concept of unstable seating runs counter to conventional human factors/ergonomics guidelines for seated workspace design. This commentary does not question the role and/or benefits of stability balls when incorporated in an exercise and fitness program or in therapeutic practice. However, employees using stability balls as chairs for traditional seated office work have additional safety considerations in an office environment. These might

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be justifiable risks if the practice has a definitive benefit to the promotion of health. However, although the existing body of literature is small and the studies have limitations, the preponderance of available evidence call into question even the theoretical basis underlying the purported health benefits of the unstable sitting practice. The literature to date does not suggest significant health benefits to justify unstable sitting as a health promotion practice. Until studies demonstrate and confirm more conclusive benefits, the practice of stability ball sitting should be viewed skeptically as a general workplace recommendation in the interest of health or wellness.

Disclaimer

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References

1. Church TS, Thomas DM, Tudor-Locke C, et al. Trends over 5 decades in US occupation-related physical activity and their associations with obesity. *PLoS One*. 2011;6:e19657.
2. Tudor-Locke C, Schuna JM Jr, Frensham LJ, Proenca M. Changing the way we work: elevating energy expenditure with workstation alternatives. *Int J Obes (Lond)*. 2014;38:755–765.
3. American National Standards Institute/Human Factors and Ergonomics Society. *ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations*. Santa Monica, Calif: Human Factors and Ergonomics Society; 2007.
4. Chaffin DB, Anderson GBJ. *Occupational Biomechanics*. 2nd ed. New York, NY: John Wiley & Sons; 1991.
5. Andersson GBJ, Ortengren R, Nachemson A, Elfström G. Lumbar disc pressure and myoelectric back muscle activity during sitting. I. Studies on an experimental chair. *Scand J Rehab Med*. 1974;3:104–114.
6. Turner K. 10 ways to sneak in a workout on a busy day. *Seattle Times*. September 1, 2013. Available at: http://seattletimes.com/html/health/2021705932_turnerexcusesxml.html. Accessed March 27, 2014.
7. webMD Gym Smarts. Exercise ball at your desk [video]. Available at: http://www.webmd.com/fitness-exercise/video/exercise-at-your-desk-ball. Accessed March 27, 2014.
8. wikiHow. How to use an exercise ball as a chair. Available at: http://www.wikihow.com/Use-an-Exercise-Ball-As-a-Chair. Accessed March 27, 2014.
9. Luciani J. 10 sneaky ways to fit a workout in your day. *Shape Magazine*. Available at: http://www.shape.com/weight-loss/weight-loss-strategies/10-sneaky-ways-fit-workout-your-day/slide/5. Accessed January 21, 2014.
10. McGill SM, Kavcic NS, Harvey E. Sitting on a chair or an exercise ball: various perspectives to guide decision making. *Clin Biomech*. 2006;21:353–360.
11. O'Sullivan K, O'Sullivan P, O'Keeffe M, et al. The effect of dynamic sitting on trunk muscle activation: a systematic review. *Appl Ergon*. 2013;44:628–635
12. Gregory DE, Dunk, NM, Callaghan JP. Stability ball versus office chair: comparison of muscle activation and lumbar spine posture during prolonged sitting. *Hum Factors*. 2006;48:142–153.
13. 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;40:199–205.
14. Beers EA, Roemmich JN, Epstein LH, Horvath PJ. Increasing passive energy expenditure during clerical work. *Eur J Appl Physiol*. 2008;3:353–360.
15. Speck RM, Schmitz KH. Energy expenditure comparison: a pilot study of standing instead of sitting at work for obesity prevention. *Prev Med*. 2011;52:283–284.

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