Journal of Bodywork & Movement Therapies (2015) 19, 434—441

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YOGA METHODOLOGY

Sirsasana (headstand) technique alters head/neck loading: Considerations for safety

Rachel Hector, M.S. , Jody L. Jensen, PhD*

Department of Kinesiology & Health Education, University of Texas at Austin, 2109 San Jacinto Blvd D3700, UT Mail Code: D3700, Austin, TX 78712-1415, USA

Received 19 May 2014; received in revised form 2 October 2014; accepted 17 October 2014

KEYWORDS
Headstand;
Yoga;
Cervical loading;
Sirsasana;
Headstand forces;
Inversion

Abstract *Background:* This study examined the weight-bearing responsibility of the head and neck at moments of peak force during three headstand techniques.
Methods: Three matched groups of 15 each (18—60 years old) were formed based upon lower limb entry/exit technique: symmetrical extended, symmetrical flexed, and asymmetrical flexed. All 45 practitioners performed 3 headstands. Kinematics and kinetics were analyzed to locate peak forces acting on the head, loading rate, center of pressure (COP) and cervical alignment.
Findings: During entry, symmetrical extended leg position trended towards the lowest loads as compared to asymmetrical or symmetrical flexed legs (Cohen's $d = 0.53$ and 0.39 respectively). Also, symmetrical extended condition produced slower loading rates and more neutral cervical conditions during loading.
Interpretation: Subjects loaded the head with maximums of 40—48% of total body weight. The data support the conclusion that entering the posture with straight legs together may reduce the load and the rate of change of that load.

Introduction

Since its introduction into American culture over a century ago, yoga has gained popularity as a modern method of obtaining states of meditation, wellness and physical fitness. Now a 6 billion dollar industry, this practice has more than 15.8 million Americans regularly coming to the mat to reap its studied stress-relieving benefits (YIAS, 2008). Practitioners perform complex postures and conscious breathing exercises shown collectively to reduce stress, improve mood, bolster immunity, increase flexibility, improve sleep and aid in recovery processes (Bower et al., 2005; Cohen et al., 2004; Curtis et al., 2011; Gururaja et al., 2011; Hedge et al., 2011). However, as

* Corresponding author. Tel.: +1 512 232 2685; fax: +1 8 512 471 8914.
E-mail addresses: rachelhector@utexas.edu (R. Hector), jljensen@austin.utexas.edu (J.L. Jensen).

http://dx.doi.org/10.1016/j.jbmt.2014.10.002
1360-8592/

the study of physiological aspects of yoga expands, the biomechanical aspects of what actually takes place on the mat are being ignored. The body often moves into uncommon positions within the context of yoga. Inquiry into the structural impact of potentially risky positions is needed due to the repetitive nature of yoga practice, the lack of biomechanical research in this arena, and yoga's growing popularity across all age groups.

Various pairings of spinal action (eg: flexion, extension) and body position (eg: kneeling, supine) make up the asana, or posture, portion of a yoga practice. Inversions, often encouraged due to the level of challenge and benefits, present a particularly atypical deviation from daily activity. Improved focus, reduced heart rate, calming effects, encouragement of venous return, movement of lymph, improvement of immune function, flush of toxins and strength gains in the trunk, upper body and respiratory diaphragm are all touted as benefits accrued in yoga inversion practices. Headstand, known as the "king of all postures" is held up in yogic literature as a cure-all for issues of circulation, the common cold, back pain and depression (Iyengar, 1966). Scientists agree with Iyengar when it comes to healing depression with yoga (Woolery et al., 2004) and have observed marked shifts in circulation during and shortly after the pose (Rao, 1968). In 1924, Kuvalayananda, found increased blood pressure readings in 11 healthy headstanding adults slowly dropped during the static phase of the posture (Kuvalayananda, 1924). Forty-four years later, Shankar Rao validated Kuvalayananda's work, and noted that heart rate was lower in headstanding than standing, inspiratory capacity was greatest upside down and that oxygen utilization in headstand was greater than in standing or supine positions (Rao, 1962a,b, 1968). In addition to lowering heart rate, Manjunath and Telles (2003) also found that two minutes of headstand increased sympathetic tone in male practitioners.

Despite decades of inquiry on the physiological changes during inversions, the literature is markedly devoid of research on the structural aspects of loaded inversions such as headstands. Research findings in other fields have delineated potential at-risk circumstances for the discs and vertebrae of the spine. Cadaver cervical spine failure loads have been reported within a range of 300 N—17 kN (Cusick and Yoganandan, 2001) with men consistently having 600 N greater loading capacity than women (Pintar et al., 1998). Bearing larger loads without incurring damage does not appear to be a product of practice. Examination of the cervical conditions of African wood-bearers, individuals practiced at loading the head, found increased degeneration and pain among male and female wood bearers bearing increased loads (Jager et al., 1997; Josaab et al., 1994). Although the discs and vertebrae are intended to aid in redistribution of force, the ability to do so depends on size, shape, and condition (Einhorn, 1992; Adams et al., 2000). Intervertebral mobility, especially in the cervical spine, generally decreases with age (Prescher, 1998). Disc degeneration increases both as vertebral mobility decreases and as discs are subjected to large, repeated or asymmetrical loads (Walter et al., 2011; Lotz and Chin, 2000; Matsumoto et al., 2010). Nearly 60% of the current United States yoga population currently falls within at-risk categories in terms of age (35—70) for disc degeneration, thus investigation into magnitude and direction of forces acting on the head is warranted (YIAS, 2008; Matsumoto et al., 2010).

This study is an initiation of the biomechanical examination of headstand (*sirsasana*) with a description and comparison of the loading conditions and factors that contribute to increased, asymmetrical, fixed, or flexed loading during all phases of the posture. In the most commonly practiced version headstand, forearms are on the floor, hands are clasped around the back of the skull, and the crown of the head is also in contact with the floor (Fig. 1). Typical entry (often modified by preferred yogic lineage) occurs in one of three ways: legs asymmetrical, legs symmetrical and bent, and legs symmetrical and straight (Fig. 2). Entry and exit techniques are generally paired and stability, or the static performance of the pose with legs vertical, is without noticeable difference across all techniques. In this study we quantified baseline estimates of average and maximum forces acting on the head and neck during the all three phases of the headstand: entry, stability and exit. Forces were partitioned by technique across the three phases to determine if technique played a role in the magnitude of cervical loading. Loading rate, neck angle, and center of pressure (COP) were determined to estimate the stiffness of the tissues in load-bearing, lateral movement of the head, and potential flexion during loading in headstand.

Methods

Participants

Forty-five subjects were recruited from the local yoga community in Austin, Texas. Participants were screened prior to arrival and subsequently recruited based upon age (18 years old and up), self-report of freedom from chronic neck injury, and ability to perform a supported headstand for five breath cycles. Individuals performing headstands outside of the context of yoga practice were not

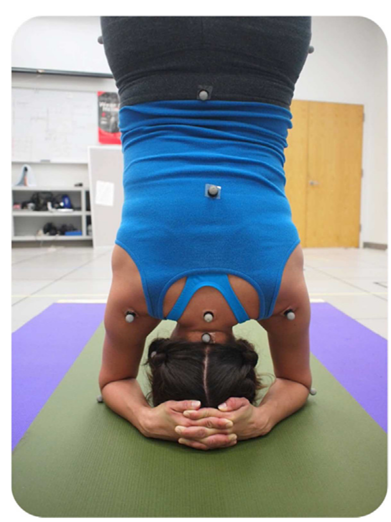

Fig. 1 Visual representation of upper body in sirsasana (headstand).