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Cardiopostural Control Variability Following Yoga in Persons with Normal versus Flat Foot

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The design of the human body is meant for performing various functional activities with optimal adjustments of its mechanical postures and suitable adaptations within the systems to conserve energy. Understanding of cardiopostural control and balance in conditions like flatfoot may be sought from an understanding of human biological evolution in preventive cardiology. During the evolutionary process, the adaptation of upright posture severely amplified the effect of the hydrostatic effect of the gravitational force on cardiovascular system.[1] Upright position adaptability is still in the process of optimization, individual differences exist in hemodynamic regulation during upright position.[2] The present study is one example to prove the internal adjustments of physiological functions for mechanical adjustments of the body in various postures with normal feet and flatfeet. The study was focused on cardiopostural control variability following yoga in normal feet and flatfeet individuals (boys and girls) with a sample of 60 (boys 30 and girls 30). The prevalence of flatfoot in the present study correlates with a recent study conducted on 300 medical students, where females had a higher prevalence.[3] In this study, heart rate variability (HRV) was assessed for quantification of sympathetic and parasympathetic regulation and the Center of pressure (COP) On Wii Balance board (WBB) in three positions, during erect bipedal stance (OB), left leg stance (RS), and right leg stance (LS).

A good posture with a conditioned musculoskeletal system and intact nervous system (NS) forms a stable base for effective autonomic regulation. Cardiopostural control is internally directly linked to posture, postural control, balance, and kinetic chain activation during any static or dynamic position. Posture refers to the attitude assumed by the body at any point of time with stability during sitting, standing, sleeping, walking, running, or transition from one position. Posture is maintained with coordinated muscular work and alignment of joints concerning gravity under the influence of NS. The NS responds to all sensory information from vestibular, visual, and proprioceptive input and produces suitable motor output to maintain stability in each posture. Postural control is defined as "the act of maintaining, achieving, or restoring a state of balance during any posture or activity."[4] Postural control can be assessed with the plotting of the COP and its location or trajectory.[5]

Interactions between the joints and muscles (Kinetic chain) are, essentially, the basis of maintenance of posture. Good posture forms the base for optimal cardiopostural control. The kinetic chain or kinematic chainrefers to interconnected and overlapping segments of the body which produces force by muscle activation.[6] Motion of one segment in body might influence the other neighboring joints and muscles, thereby activation of a kinetic chain, with suitable recruitment of muscles in groups with proper synergism. Any change in alignment, bone, joint, and muscle (e.g., flatfoot and deranged normal anatomy) may alter the composition of the kinetic chain for optimization of function in that situation. Most widely accepted method for assessment of postural stability is the use of force platform. In recent studies, WBB also gave good comparable and reliable results when compared with force platform. Balance is measured by assessment of movement of COP trajectory in anterior and posterior directions, medial, and lateral (ML) directions. Balance is a state of the body, in which all its segments are in equilibrium (Galley and Forster, 1982, page 158) due to its ability to balance net external and internal forces.[7]

Postural control depends on body's ability to generate optimal strength through selection of postural control strategies. Common postural control strategies found in body for the maintenance of balance in static postures are ankle and hip strategy.[8] In erect bipedal standing both ankle and hip strategies work together but anteroposterior is balanced predominantly by ankle strategy, whereas medial to lateral directional is done by the use of hip strategy. Positions other than standing such as tandem standing ankle and hip strategies will work separately, that is, medial lateral balance is managed at ankle by invertors and evertors whereas in anteroposterior (AP) direction balance by hip strategy loading and unloading.[9]

These kinds of synergistic adjustments during movement variability are basically to minimize the COP transitions to conserve energy. In the present study, WBB was used to measure COP location in a yoga position in normal and flatfoot individuals. These differences may be further influenced by anatomical or physiological musculoskeletal variations. Any change in position (either static or dynamic) by work of the musculoskeletal system needs hemodynamic support from the cardiovascular system with compensatory changes in autonomic NS excitability for subsequent adjustments in heart rate and systemic vascular resistance. During (OB) on board erect bipedal stance, COP variability in AP direction (OB-COPy) and ML direction (OB-COPx) in normal foot (NF) persons were similar in boys and girls, and no change in COP before and after yoga training. Even in Flat foot (FF) persons also similar findings were observed. COP values in FF subjects were positive in AP and ML direction meaning away from the center of the body, but in NF subjects, they were negative which means that the point is well within the base formed by feet. During one-leg standing, COP values were positive and greater than bipedal stance in all groups which mean pointing away from the center of the base as body weight shifts to the stance leg. The results showed that during left leg stance girls with flatfoot had greater displacement on postural variability in the ML direction than normal foot girls and boys. During left leg sway, values were on the negative side and similar in FF and NF groups. These differences in COP may be related to anatomic pelvic differences, size of bones in boys and girls, and left and right-sidedness. Both groups responded to yoga and improved their postural control on COP, but this improvement was more in NF subjects than FF subjects.

Heart function is under constant regulation for modulation of its function by sympathetic and parasympathetic NS. It is found that measurement of HRV as cost effective, reliable, and standard method for evaluation of autonomic function regulation than invasive and marker identification. A change in the natural alignment of body segments additionally imposes demands on cardiopostural control systems, this is reflected in the measurement of HRV (time between beats). The interval between heart beats of a healthy individual is greatly variable and this variability is, further, influenced by gender and anatomical alterations. A person with healthy cardiac function, conditioning, and good regulatory capacity might have optimal level of HRV.[10] Cardiopostural control may also differ in flatfoot subjects due to altered mechanics in the body. Cardiopostural control can be evaluated by HRV variability physiologically. HRV parameters (temporal and frequency domains) are measured for all subjects before and after yoga. Heat rate was high in FF subjects than NF subjects and this difference was even more in FF boys than FF girls. After yoga training, heart rate was improved in both groups, but it is more significant in FF boys than FF girls. Root mean square of successive differences values are also reduced in both groups after yoga training. Frequency domain measures of HRV such as low frequency (LF%) and high frequency (HF%) were also done for both groups and found that LF% reduced and HF% improved. This variation was more obvious in FF boys than FF girls.

The present study helps us to understand the intricacies of interactions between multiple systems and this study creates an opportunity for need of further studies on biomechanical analysis of yoga (vrikshasana) in terms of muscle synergies, COP, mechanical modulation of plantar fascia, influence of variations in kinetic chain activations, underlying stress responses, degree of FF, other proximal mechanical derangements, intrinsic fascial tightness, and body mass of the individuals on stability of posture and autonomic variability.

REFERENCES

1. Belkaniya GS, Dilenyan LR, Konkov DG, Wsol A, Martusevich AK, Puchalska LG. An anthropogenic model of cardiovascular system adaptation to the earth's gravity as the conceptual basis of pathological anthropology. J Physiol Anthropol 2021;40:9.
2. Suojanen L, Koskela JK, Wilenius M, Choudhary MK, Hautaniemi EJ, Viik J, *et al*. Individual changes of central blood pressure in response to upright posture: Different hemodynamic phenotypes. J Hypertens 2021;39:2403-12.
3. Reddy PK, Kishve P. Prevalence of flat foot among medical students and its impact on quality of life and functionality. Int J

Res Med Sci 2021;9:1082-9.
4. Pollock AS, Durward BR, Rowe PJ, Paulal JP. What is balance? Clin Rehabil 2000;14:402-6.
5. Quijoux F, Nicolaï A, Chairi I, Bargiotas I, Ricard D, Yelnik A, *et al*. A review of center of pressure (COP) variables to quantify standing balance in elderly people: Algorithms and open-access code. Physiol Rep 2021;9:e15067.
6. Karandikar N, Vargas OO. Kinetic chains: A review of the concept and its clinical applications. PM R 2011;3:739-45.
7. Ragnarsdottir M. The concept of balance. Physiotherapy 1996;86:368-75.
8. Jeong SH, Mun A, Lee SE, Kim MJ, Lee HJ, Baek KB, *et al*. Changes of postural stability according to ankle fixation in healthy subjects. Phys Ther Rehabil Sci 2019;8:40-4.
9. Winter DA. Human balance and posture control during standing and walking. Gait Posture 1995;3:193-214.
10. Shaffer F, Ginsberg JP. An overview of heart rate variability metrics and norms. Front Public Health 2017;5:258.

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