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Physical Activity Associated with Prayer Regimes Improves Standing Dynamic Balance of Healthy People

Sami Saleh AlAbdulwahab, PT, PhD[1)*], Shaji John Kachanathu, PT, PhD[1)], Kamaldeen Oluseye, PT, PhD[1)]

[1)] *Department of Rehabilitation Health Sciences, College of Applied Medical Sciences, King Saud University: Riyadh-11433, Kingdom of Saudi Arabia*

Abstract. [Purpose] Preparing for prayers, practicing religious meditation and performing prayers are believed to stimulate the visual, vestibular and somatosensory systems, which provide the sensory information that influences human balance. The purpose of this study was to determine the effect of the Islamic prayer regime on balance. [Subjects and Methods] Sixty healthy male subjects with a mean age of 31 ± 5 years and a mean body mass index of 27 ± 2 kg/cm^2 voluntarily participated in this study. The subjects were divided into two equal groups: one group of subjects who regularly practiced Islamic prayer, and another group of non-practicing subjects. The dynamic balance of individuals in both groups was measured using a Balance Master. [Results] Adult healthy subjects practicing Islamic prayer regimes exhibited statistically significantly better dynamic balance than the non-practicing healthy subjects. [Conclusions] The results of this study support the hypothesis that religious meditation and prayers benefit human physiological function, especially balance.

Key words: Limits of stability, Dynamic balance, Meditation

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INTRODUCTION

Balance is the ability to control the center of gravity (COG) within the base of a support in a given environment. Decreased ability to control balance may increase the fear of falling, which may decrease mobility. Body balance is believed to be controlled by the visual, vestibular and proprioceptive systems, which have been shown to be stimulated by spiritual meditation, religious prayers and yoga[1–4)]. Body balance can be improved by a variety of tasks that require movement of the center of gravity, a narrowed base of support and high velocity movements[5)]. More generally, the therapeutic significance of movement-based interventions including Yoga, Tai Chi etc. was recently emphasized on neuro-cognitive aspects[6)]. As a result of the growing popularity of movement-based interventions, many researchers focus on clinical research in this area.

Islamic 'salat' prayers include both spiritual meditation and physical movements of various parts of the body and they are believed to improve equilibrium, balance, and joint flexibility as well as maintain lower limb performance[7)]. Each regular prayer includes a series of postures, movements and Quran recitations, along with other specific supplications. The prayer starts in a standing posture. Subsequently, the individual bends at the waist placing the hands on the knees while keeping the back straight (bowing). The worshipper then returns to the standing position before adopting a prostrate position with the forehead, nose, hands, knees, and balls of the toes touching the ground for several seconds. The forearms and elbows should be raised off the floor during prostration (Sujud). The worshipper sits on the legs for a few seconds before rising to stand. This sequence of motion is called 'rakah'. Rakah is repeated 2–4 times depending on the statutory number of 'rakah' in each specific prayer. There are five mandatory (regular) prayers performed between morning and night each day. Clinically, it is not appropriate to recommend Islamic prayer as an exercise to facilitate the visual, vestibular and proprioceptive systems until its efficacy is proven. Therefore, the changes in the dynamic balance of people practicing Islamic prayers need to be tested and compared with non-practicing individuals. The objective of this study was to investigate the effect of Islamic prayers on dynamic balance.

SUBJECTS AND METHODS

A convenience sample of 72 healthy males from King Saud University, Riyadh, was recruited for the present study. However, only 60 subjects were included in the present study as per the inclusion-exclusion criteria. All the protocols were approved by the research ethical committee of College of Applied Medical Sciences, King Saud University, Riyadh. The aims of the present study, the procedures

*Corresponding Author. Sami Saleh AlAbdulwahab (E-mail: swahab@ksu.edu.sa)

involved and the potential risks of the study were explained to each subject, and their written consent to participation was obtained prior to the study. Subjects were aged between 25 and 35 years with a mean age of 31 ± 5 years And a mean BMI of 27 ± 2 kg/cm^2. The subjects were divided into two equal groups (n=30): one group of subjects who regularly practiced Islamic prayer, and another group of non-practicing subjects. The inclusion criteria for the Islamic prayer group were those who regularly performed Islamic prayer as scheduled (5 times per day) during the last 5 years and those who did not regularly practice any particular established religious customs were included in the non-practicing group. Potential subjects were excluded from the study based on the following considerations: obesity, neurological disorders including peripheral neuropathy, oculovestibular disorders and major musculoskeletal conditions, such as complicated back, hip and knee pain. Subjects taking medications such as sedatives, hypnotics, anxiolytics, and antidepressants were also excluded. Both subject groups performed normal sedentary life activities and were not involved in any other exercise regimes or sports.

The standing dynamic balance of both groups was measured using the Balance Master (NeuroCom International, Inc., Clackamas, USA). The balance testing procedure measured the limits of stability (LoS) with subcomponents of reaction time (RT) (sec), movement velocity (MVL) (deg/sec), end point excursion (EPE) (%), maximum excursion (MXE) (%) and directional control (DC).

The dynamic balance assessment was performed by observing the LoS, as described by García et al[8]. The subjects were asked to stand barefoot on the force platform standing upright with their eyes open and to adopt the position of greatest stability on the dual force plates while looking at a computer monitor located to the front and at eye level. The arms were relaxed and remained parallel to the sides of the body. The toes were positioned approximately 25 cm apart. The foot position was determined by positioning a standard plastic triangle between the feet and removing it before data acquisition. The distance between the heels and the angle between the feet were 8 cm and 30°, respectively. During the test, the participants were instructed to maintain their COG position relative to a central target and to move to eight different target positions without altering their base of support. The subjects were asked to move a cursor on the monitor and follow the rhythmic motion of a moving target while projecting their center of gravity toward 8 targets located on the computer screen at intervals of 45°. The subjects were given 10 sec to move their center of gravity to each target and remain in that position for as long as possible. The anterior and posterior targets were located vertically, and the antero-lateral, lateral, and postero-lateral targets were placed symmetrically on the left and right sides. The data collected for all eight locations were RT (sec), MVL (deg/sec), EPE (%), MXE (%) and DC.

RT represents the time in seconds between the command to move and the patient's first movement. MVL is the average speed of COG movement in degrees per second. EPE is the distance of the first movement toward the designated target, expressed as a percentage of the maximum LoS distance. MXE is the maximum distance achieved during the trial. DC is a comparison of the amount of movement in the intended direction (toward the target) to the amount of extraneous movement (away from the target).

Table 1. Comparison of the dynamic balance parameters between and within groups

Dynamic Balance	Subjects Practicing Islamic Prayer*	Subjects Non-Practicing Islamic Prayer*
RT (sec) **	0.94±0.23†	1.11±0.33
MVL(deg/sec) **	3.72±0.56†	3.00±0.88
EPE (%) **	87.10±8.95†	68.67±13.88
MXE (%) **	93.50±8.26†	84.30±12.57
DC (%) **	77.20±8.34†	84.17±4.34

Mean ± SD. *: t-test ($p<0.05$). †: Reaction Time (RT), Movement Velocity (MVL), End Point Excursion (EPE), Maximum Excursion (MXE) and Directional Control (DC). **

The independent t-test was performed to analyze the data using SPSS for Windows, Version 17.0.

RESULTS

The healthy adult subjects practicing Islamic prayer recorded statistically significant better RT, MVL, EPE, MXE and DC results than the non-practicing subjects, $p<0.05$ (Table 1).

DISCUSSION

The results of the present study show that the dynamic stability of the subjects practicing Islamic prayer was significantly better than that of the non-practicing individuals. The results could be related to the physical and mental activities associated with Islamic prayer. Religious meditation and prayers have been found to promote relaxation and a healthier, more balanced condition of the human mind and body[9, 10].

Studies on the benefits of 'salat' have revealed that it improves not only spiritual well-being, but also mental and physical health, improving muscle strength, joint mobility and blood circulation, when performed correctly and with the right postures[11]. A study reported that the motion of the joints and concentric and eccentric muscle actions during prayer play an important role in postural stability and balance[12]. The choice of this sensorimotor task was justified in that it involves only low-amplitude body movements and that control of the latter requires only low-intensity forces. More precisely, maintaining body sway requires body movement control via activation of muscular reaction forces through the points of contact with the ground. This means postural stability depends on muscle components and visual, proprioceptive, tactile and vestibular sensory inputs[3]. Other studies of humans during weight bearing have also reported thresholds of joint receptors[13] vision, joint, and vestibular receptors[4].

The central nervous system (CNS) has to integrate information received from several sensory inputs in order to

regulate upright control of the center of mass (COM). These inputs come from vestibular, visual, and somatosensory sources and originate from within a number of different body segments. Depending on the balance task the proportion of these inputs used to balance control may vary[14–17].

During the preparation for 'salat', worshippers clean and gently massage their feet for several seconds with water five times daily. This action is believed to facilitate the plantar sensory organs thereby improving dynamic balance. An intuitive relationship is known to exist between increasing loss of foot sensibility and loss of balance[18]. The maintenance of standing dynamic balance depends on a range of somatosensory inputs. Tactile sensitivity within the foot strongly influences the maintenance of standing balance[19]. Massage therapy has also been shown to positively affect balance control[20].

Lower-limb sensory information may originate from mechanoreceptors in the feet, joint receptors in the capsule of the ankle, cutaneous receptors adjacent to the ankles and proprioceptors within the leg muscles. Small postural movements produce relatively large pressure changes under the feet because of the large mass of the body; therefore, receptors in the feet may provide significant information about body sway. There is some evidence that receptors in the feet may provide significant sensory input to control standing[21]. The act of regularly cleaning and massaging the feet during ablution in preparation for the prayer ritual may be a source of sensory stimulation increasing the sensory input and improving the balance of subjects practicing the Islamic prayer regime.

After standing and reciting verses from the Quran, worshippers bow with an 80–90° forward movement of the vertebral column at the lumbar joint over the hip joints with both arms straight and the hands grasping the two extended knees. After a few seconds, the worshipper gradually returns to the standing position until the vertebral column is vertical[22]. Stretching of the spinal extensor, hamstring, and calf muscles occurs in the bowing position. Holding the stretches for several seconds would increase the flexibility of the stretched muscles. A previous study showed that hamstring flexibility is a core component in the maintenance of postural stability and balance[23]. Increased hold times during stretching of the hamstring muscles resulted in increased flexibility[23]. A stretching program performed regularly for several weeks resulted in meaningful improvements in a range of motions[24]. Hamstring activation has also been observed with respect to reach in the posterior direction[25]. These cited studies provide an explanation for the better standing dynamic balance observed in the Islamic prayer-practicing group compared to that of the non-practicing group.

Movement from standing to bowing to standing during prayer may function as an exercising help the worshipper adjust the center of gravity over the feet and to control balance when the center of gravity falls out of the base support. Poor adjustment of the center of gravity is known to impair balance[12].

The postural and tonic labyrinthine reflexes are initiated by the force of gravity on the receptors of the otolithic organs in the utricle of the inner ear. The vestibular system is integral to balance control. The paired vestibular organs include three orthogonal semicircular canals and two otolith organs, which provide continuous input to the brain about rotational and translational head motion and the head's orientation relative to gravity[26]. The movements performed during salat from the vertical natural position to prostration at different speeds may improve the sensitivity of the vestibular system, which maintains the steadiness of postural equilibrium.

During 'salat', frequent changes in body posture, joint angles, muscle length and speed of movement generate complex positional senses in the brain stem and cerebellum[27]. The concentric and eccentric actions of all the postural antigravity muscles help strengthen the flexors and extensors of the neck, spine and knee, and improve flexibility, especially the dorsiflexor, hamstring and erector spinae muscles. The physiological and biomechanical changes occurring in the Islamic prayer regime may explain the better dynamic standing balance observed in the subjects practicing Islamic prayer.

The results of the present study show that movement velocity and maximum excursion were lower in the non-practicing group. Decreased movement velocity may indicate impaired muscle fiber recruitment and adaptive behavior to minimize risk[28]. Therefore, postural control during a functional activity, such as leaning toward a target, can be improved by daily Islamic prayer in the same manner as passive coping strategies such as external locus control and chance locus control. Directional control and maximum excursion, which are indicative of body position in space and movement coordination, were low in the non-practicing group. The non-practicing subjects appeared to exhibit less postural control and perception owing to infrequent activation of the trunk and lower extremity flexor and extensor muscles and limited facilitation of the somatosensory and vestibular systems compared with subjects practicing Islamic prayers five times daily.

In summary, the result of the present study support the assumption that religious meditation and prayers (such as Islamic prayers) beneficially influence human performance, particularly balance. Islamic prayer routines may present beneficial training protocols for improving dynamic standing balance. Therefore, any exercise protocol proven to be beneficial to humans should be consider beyond its religious aspect. As it is known that dynamic balance is better in subjects practicing a particular religious regime, future research should investigate the fall rate of the elderly in relation to this concept.

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