COMPARISON OF POSTURE AND ANTHROPOMETRIC COVARIATES OF PHYSICALLY ACTIVE AND SEDENTARY INDIVIDUALS IN ELDERLY POPULATION

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INTRODUCTION

Physical activity is an important factor in minimizing age related adaptations in elder population. Physical activity defines significant energy expenditure through body movement. Physical activity ranging from everyday activity (e.g., walking, house hold activity etc.) to specific form of activity (e.g., cycling, dancing, swimming, gymming etc.) Evidences suggested that physical activity along with specific form of exercises upholds quality of life by stabilizing posture, balance, functional capacity thereby preventing risk factors (e.g., fall, Injuries etc.) in elder population. (Skelton et al. 2001)

Inactivity leads to reduction of 'threshold' required to enhance everyday activity in elderly population. (Young A et al. 1999) There by inducing Progressive age-related complications like Disturb balance, reduce receptors sensitivity (Golgi tendon organ), Reflex arch dysfunction (Reduce reaction time/Reduce reflex speed), Incoordination, Audio-visual dysfunction etc. (Skelton D. A. et al. 2001) Several musculoskeletal risk factors associated with aging are mainly due to inactivity of posture and related muscles signifies impaired body functions. (Lord SR et al. 1991)

Ideal posture is an ability of the body, required for daily activity, body movement & physical activity. Ideal posture is achieved & maintained by correct position of centre of gravity along with proper base of support during static & dynamic conditions. Neuro muscular coordination is required to maintain ideal posture, which is governed by visual, vestibular, proprioceptive, motor inputs and exteroceptive system of body, which helps to keep the centre of gravity, body balance and base of support according to the body requirements. Gradual impairments in ideal posture will be significantly observed in older population. Lack of postural control causes increase fall risk, incoordination, and imbalance. Early detection of these problems helps to prevent elderly from significant age-related risk factors. (Sieńko-Awierianów et al. 2018) Ideal posture reduces the abnormal forces act between muscles and bones, thereby keeps all the supportive structure of musculoskeletal system aligned and reduces the risk of progressive age-related deformation over different joints in elderly population. (Chen KM et al. 2008).

Posture may depend on the morphology, psychology, and environmental patterns of health. Postural analysis states the symmetrical pattern of all body components during static and dynamic postural activities and it is an important key factor to evaluate abnormal and asymmetrical body posture. Abnormal posture consists of joint mal alignment along with inactivation pattern of muscles related with bones and joints, this will lead to increase energy conservation during gait cycle, which result in pain and early fatigue of muscles in older populations. (Ruivo et al. 2014).

Forward head posture and forward shoulder posture are the main two aberrations which are seen in adolescents. Protrusion of the head in the sagittal plane is termed as FHP and it is linked with shortening of the sternocleidomastoid and upper trapezius muscles whereas forward shoulder posture is due to the shortening of pectoralis minor length. It has been found in many studies that craniovertebral angle is generally small in subjects who have forward head posture (Ruivo et al.2014). Different types of exercises have been seen in maintaining good body posture and to correct deformities and pain generated through poor posture. Exercise programs such as Pilates (DeFonseca et al. 2009), stretching (Kluemper et al. 2006, Roddey et al. 2002), and strength training (Barrett 2010, Falla et al. 2007) have shown to improve posture and reduce pain (Lahovski et al. 2012). Along with age related postural adaptation, aging also modify body composition (Loss of Muscle mass, strength - Responsible for uneven falls and balance) and anthropometric parameters (Height, Weight, BMI, Body density & Waist Hip Ratio) results in morphological changes (In Ectomorphs, Mesomorphs & Endomorphs) in elderly populations. Physical activity reduces the chances of age-related lifestyle factors (BMI, Waist circumference etc.) there by preventing elderly population from both primary and secondary disease conditions. Evidence suggests, elderly who involved in regular physical activities are healthier and showing favourable anthropometric parameters value as compare to inactive elderly population. (Dunsky et al. 2014), (Leite et al. 2014)

Need of the study

Due to the aging, the neuromuscular system undergoes physiological and morphological alterations that lead to decreased muscle performance and functional capacity. Combined with a sedentary lifestyle, these alterations reduce the functional reserve capacity of older individuals, making them physically weaker, slower and with reduced motor coordination when compared to young adults. Therefore, such changes associated with physical inactivity may lead to fast

deterioration of older individual's functional capacities. Individuals who are physically active have fewer physical limitations that impact the quality of their lives.

Postural control also deteriorates during the aging process. Intrinsic factors related to neuromuscular control, as well as extrinsic factors such as the environment may result in loss of balance and, consequently, in falls. Some studies suggest that postural instability is one of the most common causes of falls among older individuals. Falls currently represent one of the largest public health problems and are the main causes of death among older individuals. The maintenance of active lifestyle is recommended as an important strategy for preserving the physical aptitude of older individuals since it preserves functional capacities and reduces falls.
So, due to the lacuna in awareness of physical activity, thus to promote physical activity and correct abnormal posture developed due to sedentary lifestyle and abnormal pitting pattern. The importance and need of physical activity are required in all age groups.

METHODOLOGY
This was an experimental study where we used convenient sampling method to collect sample of 64 healthy and asymptomatic elderly population (above 60 years of age). Based on mentioned inclusion and exclusion criteria population was included in the study.

1. INCULSION CRITARIA - Age group above 60 years, both males and females
2. EXCULSION CRITARIA - Recent fracture, mental illness, subjects with history of neck/shoulder surgeries, subjects with disturbed gait and coordination, psychologically upset and less cooperative.

PROCEDURE
1. FORWARD HEAD POSTURE - In this study ON protractor mobile application was used to measure Forward Head Posture which is freely available on Google app store. This application helped to draw angle by touching the surface at reference points and taking picture of it. For measuring the angle participants were asked to sit on a stool and focus on a point on wall at eye level. The angle between the C7 spinous process and tragus of the ear was measured. [9]

2. FORWARD SHOULDER POSTURE (FSP) - FSP is measured by taking the length of pectoralis minor through Set Square by making the patient lie in supine position and ask the patient to bend their elbow and put it on the abdomen it is been suggested by the therapist it is the best position to test the pectoralis length because shoulder is slightly internally rotated and joint is properly locked inside the glenoid cavity. The distance between the treatment table and posterior acromion process is measured through set square. A distance of 2.54cms is considered normal and lesser than that may have FSP. A set square of 8cm length and 8cms breath was used to measure the distance from treatment table to the posterior acromion process of the subjects were measured.

3. SCAPULAR ASSYMETRY THROUGH LSST- The length between the inferior angle of scapula and adjacent vertebrae is measured in centimetres on the both sides and the dominating side is subtracted from the non-dominating side. The readings were taken in three positions in 0, 45, 90 degrees of abduction. A length of 1.5cms is considered normal and lesser than that may have scapular asymmetry. There is high Inter- Rater and Intra- Rater reliability has been seen in all three positions (ICC.0.923). Intra-rater reliability (ICC. 0.87) was good to high level was seen, but ICCs scores for inter-rater reliability was poor to good (0.63 to 0.860) was seen.

4. LUMBAR LORDOSIS - Flexicurve of flexible ruler was used to measure the spinal curvature i.e., lumbar lordosis among the elderly individuals. Flexicurve was bent over the spine and markers were made from C7 to S2 vertebra. The curve was traced on the paper and lumbar length and width was measured using a ruler. Lordosis index was calculated as:

$$IL = LW/LL \times 100$$

where, LW is Lumbar Width which is horizontal distance in sagittal plane to the point of widest lumbar curvature LL is Lumbar Length which is the vertical distance from the C7 to the sacral region. The lordotic index showing higher mean value 16.17 with a standard deviation of 5.0 whereas kyphosis index was 9.27 with a standard deviation of 2.1. This showed that the most affected region among the study group was the lumbar (lower back) region than the thoracic and cervical spine.

5. PHYSICAL ACTIVITY- Physical activity was calculate using Rapid Assessment of Physical Activity (RAPA) RAPA consists of 2 components

named RAPA 1 and RAPA 2. Time duration for RAPA was 30 minutes. It assesses common physical activity on every day or most days of the week and comprises added questions to assess strength and physical activity because these activities are associated with prevention of falls. It had nine items' questions and subject was instructed to answer either 'yes' or 'no' according their current level of physical activity. Reliability=0.65 Sensitivity= 0.73 specificity=0.75 Cut off score is 6 or above.

For men:

$$BD = 1.10938 – 0.0008267(Y) + 0.0000016(Y2) – 0.0002574(Age)$$

where Y= sum of Chest, Abdominal and Thigh skinfolds in mm

For Women:

$$BD=1.0994291 – 0.0009929(Z) + 0.0000023(Z2) – 0.0001392(Age$$

Where Z = sum of Triceps, Thigh and Suprailliac skinfolds in mm.

6. ANTHROPOMETRIC COVARIATES – • BMI - The BMI was calculated using the ratio of weights in kilogram which was measured on a weighing machine divided by square of height in meters which was measured with a stadiometer. • BODY DENSITY – Jackson- Pollack method was used to measure the body density using skinfold calliper.

• WAIST: HIP CIRCUMFERENCE RATIO - The measurement of waist hip circumference is related to the type of tape which should be a resistant and non-stretchable.

a. TIGHTNESS AND TYPE OF TAPE – The WHO protocol states that for the measurement of both hip and waist circumference tape should not pulled so tight that it constricts but should snug around the body.

b. POSTURE AND OTHER FACTORS - At the time of measurement following instructions were performed: • Subjects were made to stand with arms aside • Feets were close together and weight was evenly distributed on both feets. • Circumference will be measured when subjects expire, and lungs are at their functional residual capacity. • Subjects were asked to take few breaths and relax their body before measurement

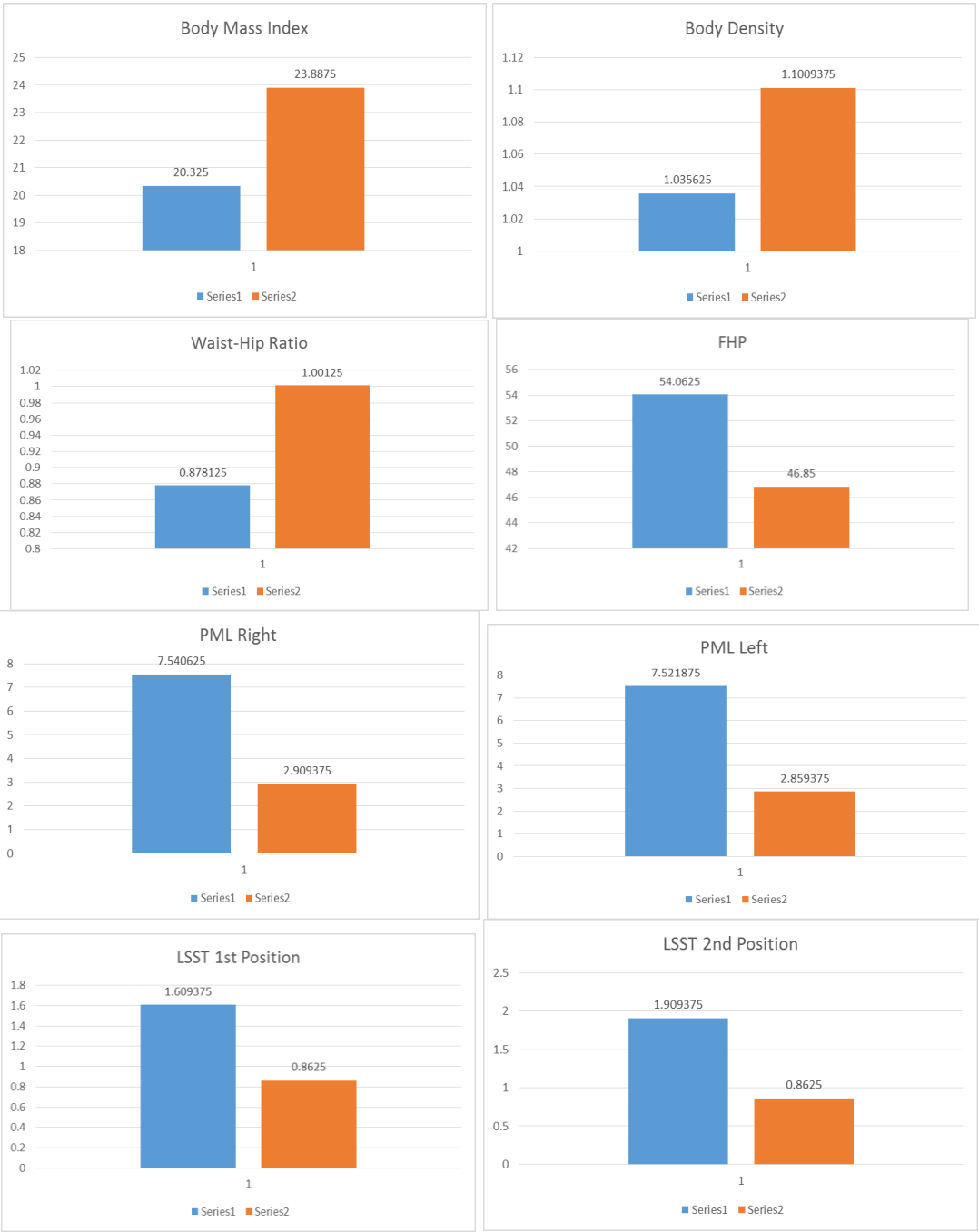
c. PLACEMENT OF TAPE- Hip Circumference- It should be taken from the widest parts of the buttock. Waist Circumference – It should be taken to a midpoint between the last palpable rib and upper part of iliac crest.

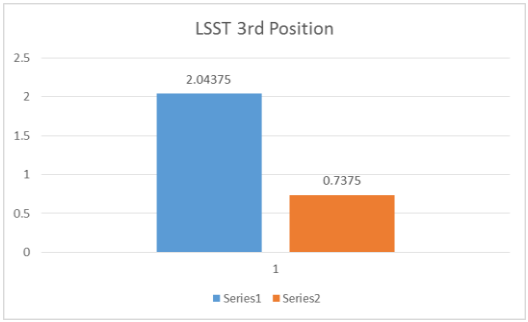
Data Analysis - The data was entered and analysed on MS Excel 2007 and then mean, standard deviation and t – test values were calculated which showed the data was significant as the elderly individuals who had not involved themselves in any type of physical activity tends to develop faulty posture.

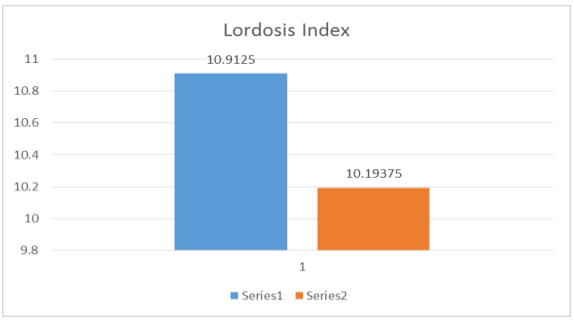
Sr.No	Variables		Physically Active	Physically Inactive	t-Test value	Significancelevel
1.	Age (Year)	Mean	64.53	64.71		
		SD	3.25	3.40		
2.	Body Mass Index (Kg/m²)	Mean	20.32	23.89		< .00001
		SD	1.91	3.37	-5.11	
3.	Body Density (meter ³)	Mean	1.03	1.10		< .00001
		SD	0.01	0.02	-12.99	
4.	Waist-Hip Ratio	Mean	0.87	1.00		< .00001
		SD	0.08	0.23	2.73	
5.	Forward Head Posture (Degrees)	Mean	54.06	46.85		
		SD	3.63	3.90	7.64	< .00001
6	Pectoralis Minor Length Right (Centimeters)	Mean	7.54	2.90		
		SD	0.28	0.32	60.02	< .00001
7	Pectoralis Minor Length Left Cm	Mean	7.52	2.85		
		SD	0.27	0.26	67.94	< .00001
8.	LSST 1st Position Cm	Mean	1.60	0.86		
		SD	0.71	0.53	4.75	< .00001

9.	LSST 2nd Position Cm	Mean	1.90	0.86		
		SD	0.11	0.37	15.20	< .00001
10.	LSST 3rd Position Cm	Mean	2.04	0.73		
		SD	1.19	0.43	5.82	< .0001
11.	Lordosis	Mean	10.91	10.19		
		SD	0.29	0.29	9.69	< .00001

Result - After statistical analysis of all physical factors which directly or indirectly affect the POSTURE and ANTHROPOMETRIC COVARIATES of the individual shows that the mean, standard, deviations and t-test values for craniovertebral angle, pectoralis minor length, lateral scapular slide test, lumbar index and anthropometric covariates were altered and it will depend upon the body type, type of physical activity you perform and morphology of the subjects. The data we found showed the significant result.







Series 1: Physically active Individuals, Series 2: Physically Inactive Individuals

In the graphs it can be seen that the physically active individuals (series 1) were having the Body density, Body Mass Index, waist-hip ratio, Forward Head Posture, Forward Shoulder Posture, Lordosis and Pectoralis Minor Length values somewhere near the normal values in all three positions (0, 45, 90 degrees) than physically inactive individuals (series 2) although there were not much variations in the mean age values.

DISCUSSION

In the literature, studies describing the health-related physical fitness of Indian elderly population are rare. Evaluating the trends in physical fitness component levels among elderly should provide useful information on which to base public policies to promote better quality of life and general health status within this population, both today and in the future The objective of the study was to evaluate the effect of physical activity on anthropometric covariates and body posture in elderly population. Various tests which showed a high reliability were used for the assessment of posture and anthropometric covariates.

In many previous studies it has been found that there is very beneficial effect of physical activity on health and body posture of the human body. Musculoskeletal disorders are extremely common worldwide and affect people of all ages, gender and socio-demographic background in society. The purpose of this study was to perform evaluation of ergonomic postures, anthropometric covariates and level of physical activity among elderly population of Delhi NCR by using various assessment methods of posture, anthropometric covariates and physical activity. In the present study, we observed that those who are physically inactive tends to develop faulty posture like forward head posture, forward shoulder posture and those who keep themselves involved in any kind of physical activity not usually get any postural aberrations and have better anthropometric values.

Body composition is a key component of health and physical fitness profiles of people. Body composition is an important component that improves maximal work capacity affecting physiological parameters. The body size and structure may be altered a little, there may be a great change on body composition by diet and exercise. The eventual cause of gaining weight that excess energy intake over expenditure or positive energy balance (Jakicic & Otto, 2006). Energy balance is affected by the energy expenditure and important factor to stimulate the energy release is the energy expenditure based on physical activity (Jakicic & Otto, 2006; Heyward, 1991) Research proves that regular participation to exercise may change the body composition and have positive effect on aging.

According to the ANOVA results acquired from the study (Yilmaz Ucan; 2013), it was examined which of the training forms was the most effective on the body composition parameters. At the end of the 10-week training, there was no statistical difference on the %BF, WHR, SF and body weight values among the Aerobic Exercise, Resistance Exercise and Combined Exercise groups. Any of the exercise groups showed similar effects.

Silanpaa et al. (2009) stated that, 47 healthy men, aged 40-65participated in their study and the subjects divided into 3 training groups. At the end of the 21-week AE, RE and CE trainings, every group showed a significant decrease on %BF value. All of the subjects (n=47) showed some decrease on their weight, BMI, WHR, and %BF values during the training period.

Chaudhary et al., 2010 concluded that after 6 weeks exercises both groups (AE, RE) showing improvement in BMI and %BF values. According to (Dolezal & Potteiger, 1998) an exercise protocol of 10-week period shows significant reduction in BMI and BF values when performing aerobic, resistance or combined exercises which concludes application of any form of exercises (aerobic or

resistance exercises) have effects on increasing energy expenditure and creating a negative energy balance and on improving body composition parameters.

Various review of literature shows a significant effect of exercises on reducing lumbar curvature (lordosis). According to the study of Farahani (2006), Foruzan (1998), and Kashanian (2010) shows direct impact of exercises on lumbar lordosis. Result states that increased lumbar lordosis observed during abnormal biomechanics and misalignments of various joints causes underlying pressure over abnormal lumbar region. Hence, 6-week exercises have a positive influence on lordosis, which helps to prevent abnormal biomechanical complications, correction of lordosis, and keep it to natural and effective position. During physical inactivity period example prolong sitting, precision activities and abnormal pelvic positioning may interfere in the normal mechanics of lumbar spine produces muscle imbalance results in abnormal curvature. Therefore, physical activity helps to correct and maintain lumbar spine curvature.

Alizadeh M.H., (2009) studied the direct relation of exercises on scapula positioning in protracted individuals they conclude that function of levator scapula and trapezius muscle are important in stabilizing the scapula in the correct position. The protracted scapula places stabilizers muscles like trapezius in lengthened and this may decrease its ability to keep scapula in normal position and therefore generating sufficient tension. A simple 6-week exercise program of stretching and strengthening of trapezius, levator scapula and pectoralis muscles increased the muscle performance of protracted individuals and improved the scapula position.

Due to continuous protraction of scapula the center of gravity of head goes anterior to the vertical axis of neck thereby increasing the load on posterior neck muscles. So, this faulty mechanism of scapula, biomechanical strain on stabilizers of neck muscles leads to prolonged protrusion of head (Forward Head Posture).

Watson and Trott examine the effect of physical activity (stretching and strengthening) on deep cervical flexors and extensors to reduce FHP. Thereby they concluded that a combination of stretching of flexors (tight structures) of neck and strengthening of the lengthened extensors of neck can be helpful in correcting FHP. Also, Pearson and Walrnsley in their study concluded that the strengthening of deep flexors and stretching of cervical extensors changed resting head posture.

LIMITATIONS

- Small sample size. Limited period of study.
- Subjects were not steady at time of assessment of posture.

FUTURE RECOMMENDATIONS

- Gold standard tools with higher reliability can be used to measure the postural aberrations.
- Lower age groups can also be evaluated.

CONCLUSION

While assessing posture, overall stance of the body is examined, alignment of body parts is checked. Bone structure is assessed for any abnormality and damage. Appearance of joints is checked for their neutral, resting position, alignment, swelling, angles and range of motion. Muscles are assessed to check if there is equal bulk on left and right side of the body. It is checked if there is any noticeable hypertrophy or atrophy anywhere. Muscle tone is checked. Skin is examined for any inflammation, discoloration or dryness. Scars, blemishes and bruising is checked. Physical attitude of the person is checked. It is observed if the subject under assessment is looking comfortable or not, it is checked if the subject appears to be able to maintain the posture with ease or not, are there any areas of tension in the body etc. This research paper also describes the various techniques implemented in order to assess the posture. From the research review performed extensively, it was found that the field under study is still under its developmental stage. The research articles when searched using the keywords Posture Assessment/ physical activity/ Anthropometric / Digital Photography in Posture evaluation are very limited and most of the obtained articles are irrelevant. None of the article obtained talk about the methodology and discuss the technical details about the process of postural assessment. The papers have mentioned the names of softwares that are used for conduction of the assessment. However, while searching on those softwares, some of them are not available on internet while some patents and also are chargeable for use. Based on above observations, and based on reviewed relevant literature the research gaps are seen. Currently available softwares are commercial and need to be purchased for carrying out the validation too. The available methods that make use of photography/ photogrammetry are semi-automated as they need some manual markings to be entered by the doctor / therapist are paid

softwares. Some of the mobile applications used to conduct posture assessment are in the process of filing. So, this is the reason I have used the methods which is easy to use in clinical practice. In the present study, we observed that those who are physically inactive tends to develop faulty posture like forward head posture, forward shoulder posture and those who keep themselves involved in any kind of physical activity not usually get any postural aberrations and have better anthropometric values. The early diagnosis of postural deficiencies along with early inclusion of elderly population in specialized additional programs of physical activity can produce good results with positive effects which is quite important. It can be concluded that certain sports and exercises for elderly population, contributes to a more effective correction of the body spatial control and improving the health-related quality of life. Health professionals and family members should pay more attention to taking preventive steps to reduce negative, musculoskeletal-related consequences. Different types of exercises have been seen in maintaining good body posture and to correct deformities and pain generated through poor posture. Exercise programs such as Pilates (DeFonseca et al. 2009), stretching (Kluemper et al. 2006; Roddey et al. 2002), and strength training (Barrett 2010; Falla et al. 2007) have shown to improve posture and reduce pain. An exercise program of 3 days per week continued for 8 weeks includes 20 minutes each session showed an excellent result as it lowered the postural pain on the VAS scale. The findings of the study suggests that physical education teachers and physiotherapists can have a very active and important role in detecting and treating of postural defects, particularly in elderly population prior to their becoming a complex entity.

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