www.aassjournal.com
ISSN (Online): 2322 – 4479
ISSN (Print): 2476–4981

Original Article

www.AESAsport.com
Received: 24/06/2016
Accepted: 20/06/2017

Prevalence of Postural Abnormalities of Spine and Shoulder Girdle in Sanda Professionals

[1]Hamed Babagoltabar Samakoush*, [1]Aliasghar Norasteh

[1]Department of Corrective Exercise and Sport Injuries, Faculty of Sport Sciences, University of Guilan, Rasht, Iran.

ABSTRACT

Background. Performing skilful movement patterns during sport practice sessions and real competition can cause negative adaptations in the musculoskeletal system. **Objectives.** The aim of this study was to investigate the incidence of postural abnormalities of the spine and shoulder girdle among professionals practising Sanda in Mazandaran province. **Methods.** Forty professional Sanda athletes participated in this study. The photogrammetric technique was used to record and measure the angle of forward head and forward shoulder. A flexible ruler was used to measure the angle of kyphosis and lordosis. **Results.** Based on the findings, the prevalence of abnormalities in the athletes was respectively: 75% forward head, 80% forward shoulder, 85% kyphosis and 65% lordosis. Also, the average angles in athletes included: kyphosis 47±4.63, lordosis 47.40±7.18, forward head 48.02±2.15 and forward shoulder 54.12±2.05 degrees. **Conclusion.** Based on the results, it appears that professional Sanda athletes have exposure to alterations in shoulder and spine position, thanks to the sporting condition and type of exercises. Of course, further studies should be performed with large samples to obtain confirmed results. However, coaches and athletes should consider special corrective exercise programmes and perform them to prevent such abnormalities.

KEY WORDS: ***Sanda, Kyphosis, Lordosis, Forward Head, Forward Shoulder.***

INTRODUCTION

Athletes are identifiable with their special postures, and a characteristic of athletes is their physical condition, which distinguishes them remarkably from others (1). To achieve any progress in sports, athletes have to undergo long-term training (2). In these programmes, each athlete—depending on the type of exercise—may be prone to certain types of anomalies or small postural deviations related to that exercise (2, 3); these postural deviations may lead to a wide range of disorders (4).

In this respect, the spinal cord of the human body—which is a very important part of the skeletal framework and accounts for the main support of the body in various activities, playing a major role in keeping the body flexible in different sports, depending on the type and nature of activities—is subjected to certain changes (3). Since this part is closely related to the shoulder girdle, its change may lead to chained variations of the shoulder girdle and make changes to its alignment (5).

The normal range of thoracic curve angle is 20 to 40 degrees and the normal range of lumbar lordosis is 20 to 45 degrees (6), which is reported by Newman (2010) for adults as 45 to

*. Corresponding Author:
Hamed Babagoltabar Samakoush
E-mail: hb.sama@yahoo.com

50 degrees and 45 degrees respectively (7). Various researchers have reported different angles for various ages: e.g. Rajabi et al. (2010) reported the thoracic kyphosis norm for the age group 15–24 years at 41.77 degrees and for the age range of 25–44 years at 42.80 degrees. Also, the range of lumbar lordosis for these two age groups is reported to be 32.20° and 41.46° respectively (8). Accordingly, some researchers reported these angles respectively as 38.5 and 56.6 degrees in the age group 15–20 years (9). In addition, the normal range of forward head and forward shoulder in the photography approach is respectively 44 to 46 and 52 degrees (10). Some sources also reported the forward head angle to be 30 to 35 degrees with other methods of measurement (9).

In natural conditions, the angles of the spine and shoulder girdle increase with increase in age (4). Abnormal changes and deviations from the ideal postural condition are not only unpleasant from the point of view of appearance, but also have negative impacts on muscle performance, making the person prone to the risk of musculoskeletal disorders and neurological disorders (11). Studies have shown that athletes are more prone to postural deviations than non-athletes. Deviations of the spine in athletes are both lateral (in the frontal plane), such as scoliosis in rocket athletes and javelin and hammer throwers, and anterior/posterior (in the sagittal plane), such as lordosis in horse riders and kyphosis in cyclists, boxers, breaststrokers, wrestlers and weightlifters (12). The phenomenon of negative adaptation of the skeletal system with the mobility needs and skills of athletes, especially in professional athletes and champions, is an important subject of study. It has attracted researchers' attention in recent years (13). In this field, various studies have been conducted on different sports athletes inside and outside Iran, and different results have been achieved from these studies. Rostami Haji-Abadi and Rahnama (2010) showed that rounded shoulder and lumbar lordosis—with 10.4% and 9.61%—are respectively the most common abnormalities in bodybuilding athletes (14). Also, Muyor et al. (2013) have pointed out the existence of hyperkyphosis (with an outbreak rate of 58.3%) in cyclists as well as its relationship with one's position on the bike (the impact of performance on the anomaly) in professional and semi-professional athletes ($p<0.01$) (15). Lichota et al. (2011) have confirmed the existence of hyperkyphosis in volleyball players and hyperlordosis in sprinters (16), which is in consonance with the results of Grabara et al. (2015) (17). In addition, Grabara (2012)—in a study titled 'Physical condition of young female basketball players'—assessed the posture of 32 basketball players aged 14–13 years. In this research, he noted a decreased thoracic kyphosis (with a mean of 27.2 degrees) in these athletes compared to non-athletes (with 30.1 degrees) and at $p<0.05$ (18).

Wushu includes two parts—namely, Taolu (dramatic movement) and Sanda (fighting). Wushu covers all Chinese martial arts and began at the time when humans fought with animals to defend themselves. Sanda is a fighting technique, the design of which is based on different styles of Chinese martial arts and traditional Chinese wrestling, such as Shuai Chiao. It is very much similar to kickboxing and Muay Thai, but with more grappling techniques.

In the martial part of Wushu, there are hand and leg movements on face guard similar to boxing and taekwondo athletes, leg movements in leg guard like those of taekwondo athletes as well as wrestling techniques, the repetition of which may lead to several physical abnormalities (19). These anomalies may negatively affect the athletes' daily lives and cause problems for them over time. Given that no investigation was found on postural abnormalities in Wushu sports that separately studied the Sanda athletes, the present study aims to investigate the anomalies of kyphosis, lordosis, forward head and forward shoulders in professional Sanda athletes of Mazandaran province in Iran. The results of this research can be applied to identify some physical abnormalities in these athletes.

MATERIALS AND METHODS

Participants. The statistical population of this research includes all professional Sanda athletes of Mazandaran province over 18 years who had participated in the Premier League in the past two years and won places in the country or overseas competitions during their sports activities. The number was 40, who were selected based on researchers' information by

the board of Wushu of Mazandaran. Moreover, the athletes used to undergo continuous exercises three times per week and had no specific injury. The average and percentage of anomalies in the 40 athletes were inspected and, in order to examine the impact of sports on the level of abnormality, the 40 subjects were divided into three groups with sports experience of less than four years, five to eight years, and over nine years respectively. Measurements were taken in March 2015 over a one-month period. Before the measurements, the subjects had undergone no hard exercise. A tape measure was applied to assess the height and a digital scale to measure weight. Furthermore, the body mass index was calculated by dividing the weight in kilograms by the square of height in metres. In order to evaluate kyphosis and lordosis curves, a flexible ruler was used. Seidi et al. have reported the validity and reliability of the flexible ruler to be high in the measurement of lumbar lordosis (89% and 92%) (20). Before the tests, the subjects were given explanations about the assessment, and all participants completed the consent form.

Kyphosis and lordosis assessing. To evaluate kyphosis, each of the subjects was asked to stand normally in front of the examiner with uncoated trunk. The examiner then marked off the T2 and T12 of thoracic vertebra. All the measurements were performed in standing position and in relaxation, and the participants were asked to divide their weight on both feet and look forward while measuring. After identifying the appropriate points, the flexible ruler was put in line with the spine so that it took the form of the area and no empty space remained between the ruler and the spine. Then, the marked points on the spine were transferred to the ruler. At last, the ruler was carefully separated from the spine and was placed on the paper and the curve was drawn on paper by pencil and the points of interest were identified (Figure 1). The distance between two points, L, and the cure depth, H, were measured by a ruler. The angle of kyphosis was then calculated using the formula $\Theta = 4 \arctan(2H/L)$ (21). In order to measure lordosis, the first lumbar and second sacral vertebrae were marked. The marked points on the spinal cord were placed on the ruler and, based on that and the formula, the lordosis angle was obtained (21).

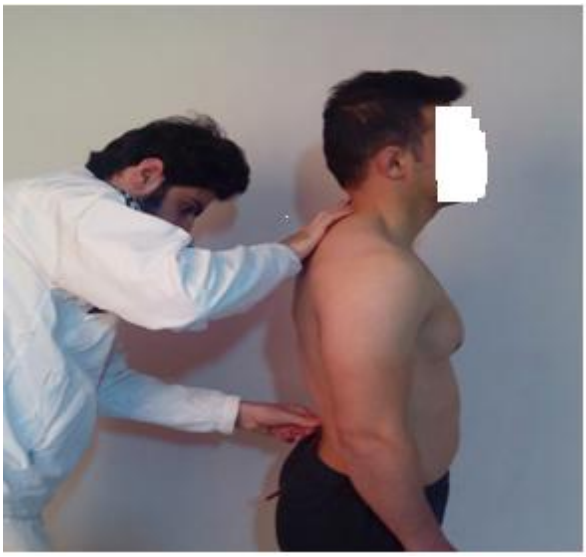

Figure 1. Kyphosis and lordosis measurements by using a flexible ruler

Forward head and forward shoulder angles. In the present study, the forward head and forward shoulder angles were measured by taking photographs of the body profile. This method has a suitable repeatability and was used in several studies; in this research, the repeatability was (ICC=0.92) (22). To use this method, first of all, three anatomic landmarks—including ear tragus, the right side acromion tubercle, and spinous process of C7 vertebra—must be determined and landmarked. Then the subject was asked to stand at a determined place next to the wall (with 23 cm distance) in such a manner that her left arm was put towards the wall. Then a photography tripod (a digital camera) was placed at a distance of 265 cm from the wall and its height was adjusted at the level of the examinee's right shoulder. At that time, the subject was asked to bend forward three times and raise her hands over her head three times and then stand normally and relaxed, and watch an imaginary point on the opposite wall (the eyes were in the direction of the horizon). Then the examiner took a photo from the body profile after a pause of five seconds. Finally, the photo was transferred into the computer, and using AutoCAD software, the joined line angle of c7 and acromion process with vertical line (the forward shoulder angle) and the joined line angle of c7 and tragus

process with vertical line (the forward head angle) were measured (22) (Figure 2).

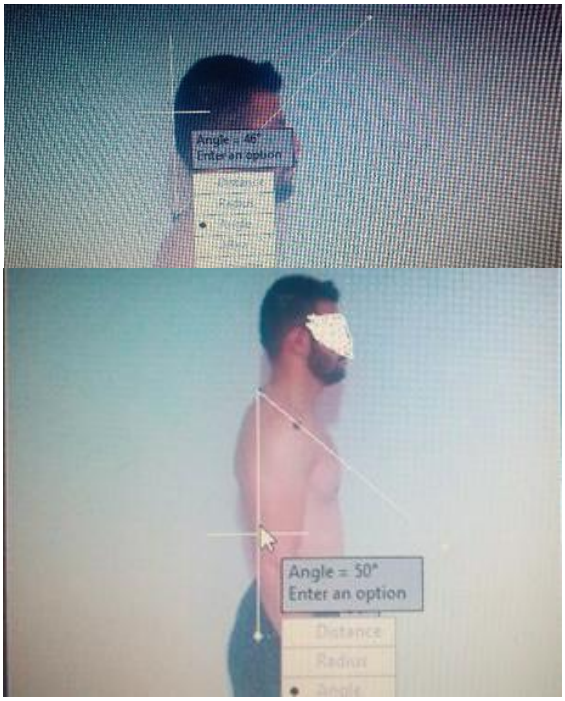

Figure 2. Forward head and forward shoulder angles measuring by photography technique.

Statistical analysis. Descriptive statistics were used to measure the averages and since the subjects included 40 people, the Shapiro–Wilk test was used to assess the normality of data distribution. Since the Shapiro–Wilk test results were not significant, data distribution was normal, and so the parametric one-way ANOVA test was used to compare the three groups of subjects. Data was analyzed using SPSS, Version 22.

RESULTS

The average and standard deviation of general characteristics, including age, height, weight, BMI, sports experience, as well as the average of the angles of the spine and shoulder girdle, are given in Table 1. Also, in Table 2, each abnormality has been reported in percentages. In addition, in this study, a report was given about the influences of the time of exercise on the rate of abnormality. For this purpose, individuals were divided into three groups with exercise experience of under four years, five to eight, and over nine years, and the results of these are expressed in Tables 3 and 4.

Table 1. Individual characteristics of subjects in three groups with sports experience of under 4 years, 5-8 years and over 9 years

Variables	With experience of under 4 years	With experience of 5-8 years	With experience of more than 9 years	Total
N	13	14	13	40
Age(year)	21±2.51	22.28±2.94	22.69±3.47	22±3.01
Height(cm)	1.78±0.04	1.78±0.09	1.73±0.06	1.76±0.07
Weight(kg)	72.23±12.28	74.5±16.04	69.07±8.76	72±12.68
Body mass index(kg/square meter)	22.56±3.63	23.26±2.98	23.04±3.11	22.06±3.17
Sports history(year)	3.53±0.51	6.07±1.07	10.38±2.21	6.65±3.15
Angle of head relative to vertical line(degree)	46.92±1.55	47.78±1.47	49.38±2.63	48.02±2.15
Angle of head relative to vertical line(degree)	52.61±1.98	54.42±1.69	55.30±1.60	54.12±2.05
Angle of thoracic curve(degree)	42.94±3.67	46.93±1.70	51.15±4.06	47±4.63
Angle of lumbar curve(degree)	44.46±7.30	46.60±6.50	51.20±6.55	47.40±7.18

There were significant differences in forward head ($p<0.009$), forward shoulder ($p<0.001$), kyphosis ($p<0.001$), and lordosis ($p<0.04$) among Sanda athletes with different sports experience (Table 3). Posthoc test (Table 4) showed a significant difference of forward head between athletes with experience of less than four years and over nine years ($p<0.01$). There were significant differences of forward shoulder between athletes with experience of less than

four years with five to eight years ($p<0.03$), and with over nine years ($p<0.002$). The results presented significant differences of kyphosis between athletes with experience of less than four years with five to eight years ($p<0.01$), and with over nine years ($p<0.001$), and also between athletes with five to eight years experience and those with over nine years ($p<0.008$). Besides, there was a significant difference of lordosis between athletes with experience of less than four years with over nine years ($p<0.05$).

Table 2: Percentage of abnormalities in athletes

Variables	Condition	N=40	Percent Of population
Angle of head relative to vertical line(degree)	Normal	10	25%
	forward head	30	75%
Angle of shoulder relative to vertical line(degree)	Normal	8	20%
	forward Shoulder	32	80%
Angle of thoracic curve(degree)	Normal	6	15%
	Kyphosis	34	85%
Angle of lumbar curve(degree)	Normal	14	35%
	Lordosis	26	65%

Table 3: One-way ANOVA to compare abnormalities in three groups of people with exercise experiences of 4 years, 5 to 8 years and over 9 years

Variables	Group	N	F	Significance level
Age (year)	Under 4 years	13	1.13	p<0.33
	5-8 year	14		
	Over 9 years	13		
Height (cm)	Under 4 years	13	2.32	p<0.11
	5-8 year	14		
	Over 9 years	13		
Weight (kg)	Under 4 years	13	0.60	p<0.55
	5-8 year	14		
	Over 9 years	13		
Body mass index (kg/square meter)	Under 4 years	13	0.16	p<0.84
	5-8 year	14		
	Over 9 years	13		
forward head (Degree)	Under 4 years	13	5.35	p<0.009**
	5-8 year	14		
	Over 9 years	13		
forward Shoulder (Degree)	Under 4 years	13	7.88	p<0.001**
	5-8 year	14		
	Over 9 years	13		
Kyphosis (Degrees)	Under 4 years	13	20.34	p<0.001**
	5-8 year	14		
	Over 9 years	13		
Lordosis (Degrees)	Under 4 years	13	3.34	p<0.046*
	5-8 year	14		
	Over 9 years	13		

*Significance level ($p<0.05$). **Significance level ($p<0.01$).

Table 4: Results of Scheffe post hoc analysis

Variables	Group	Group	Mean difference	Significance level
Age (year)	Under 4 years	8 .5 year	-1.28	0.54
		Over 9 years	-1.69	0.36
	5-8 year	Over 9 years	-0.40	0.36
Height (cm)	Under 4 years	5-8 year	0.008	0.95
		Over 9 years	0.05	0.15
	5-8 year	Over 9 years	0.04	0.24
Weight (kg)	Under 4 years	5-8 year	-2.26	0.90
		Over 9 years	3.15	0.82
	5-8 year	Over 9 years	5.42	0.55
Body mass index (kg/square meter)	Under 4 years	5-8 year	-0.70	0.85
		Over 9 years	-0.48	0.93
	5-8 year	Over 9 years	0.22	0.98
forward head (Degree)	Under 4 years	5-8 year	-0.86	0.52
		Over 9 years	-2.46	p<0.01**
	5-8 year	Over 9 years	-1.59	0.11
forward Shoulder (Degree)	Under 4 years	5-8 year	-1.81	p<0.03*
		Over 9 years	-2.69	p<0.002**
	5-8 year	Over 9 years	-0.87	0.44
Kyphosis (Degrees)	Under 4 years	5-8 year	-3.99	p<0.01**
		Over 9 years	-8.20	p<0.001**
	5-8 year	Over 9 years	-4.21	p<0.008**
Lordosis (Degrees)	Under 4 years	5-8 year	-2.14	0.71
		Over 9 years	-6.73	p<0.05*
	5-8 year	Over 9 years	-4.59	0.22

*Significance level (p<0.05). **Significance level (p<0.01).

DISCUSSION AND CONCLUSION

Various researches have indicated there are relationships between negative adaptations and structural deficiencies with their skill and movement patterns (15-17). The present study aimed to determine the postural anomalies of the spines of selected adult Sanda professionals of Mazandaran province. According to the norm reported in several studies for the related angles, our results clearly showed abnormalities in Sanda professionals. The findings of the current research in the hyperkyphosis area are in accordance with the investigations of Mayor et al. (2013) (15), Lichota et al. (2011) (16) and Grabara et al. (2015) (17), but are inconsistent with Malgorzata Grabara (2012) (18); this inconsistency can be related to the gender and age of athletes, since it was conducted on young athletes. The results for hyperlordosis in this study were in consonance with those of Rostami Hajiabadi and Rahnama (14) and Lichota et al. (2011) (16). In the context of forward shoulder, they coincided with Hajiabadi and Rahnama (14). On the forward shoulders, according to Nodsen (2009), it can be demonstrated that the shoulder arch and the thoracic arch are interrelated. Since the back has an arch, with its arch increased, the fourth or fifth thoracic vertebra and the third or fourth cervical vertebrae move forward; this move leads the shoulder to move forward (23). As shown in Tables 1–3 and 2–3, in the athletes, by increasing the exercise experience, the abnormalities increase. Accordingly, Grabara et al. (2012) reported in their study the relationship between the impact of exercise on the anterior-posterior curvature of the spine (18). Also, Sadeghi obtained a significant difference between the angle of kyphosis and forward head in professional wushu, amateur wushu, and non-athletes (24), which reflects the effect of exercise experience on anomalies in athletes.

Specific activities over the long term lead to deformation and adaptation of body to the special status (9). It seems that in the long term, defensive guards lead to kyphosis in Sanda men. Furthermore, it is believed that increased lumbar lordosis can be caused as secondary relative to kyphosis rise (6). According to Nodis's theory (2009), this enhancement of kyphosis could be a factor in increasing the forward shoulder angle in these athletes (23).

The lumbar spine is considered the axis of the body and its abnormality can affect the quality of implementation of skills (4). Lumbar lordosis is one of the main characteristics of posture and movement, which is of much importance in the development of back problems. Changes in lumbar lordosis during the movement change the stress on the back (4). Lumbar lordosis can be one of the causes of pain in athletes, preventing athletes from achieving high levels of performance (25). Various studies have proven the relationship between repetitive tasks and the rise of the head angle. Moreover, one of the causes of neck pain is the increase in the head angle, which has been proven in different studies (12). Perhaps the higher forward head angle in these athletes is caused by their physical condition, which is maintained for a long time in exercises and competitions (12).

According to the results, it seems that the entry of athletes into the professional level can be associated with the risk of skeletal abnormalities. Frequent exercises increase the strength of specific muscle groups. If these repetitive activities are associated with inappropriate body conditions, they will greatly increase the imbalance of power (4). This imbalance of strength in a vicious cycle can possibly cause some abnormalities. Often, to maintain balance in the spine, compensational abnormalities occur in the spinal cord (4). Based on these abovementioned points, it seems that movement patterns of Sanda in Wushu directly increase kyphosis; so, as a compensatory factor, it causes lordosis, forward shoulder and then forward head. On the other hand, postural disorders can cause changes in the body's centre of gravity compared with the base of support and thus problems with the balance of individuals (26). Awkward posture is not always indicative of disease; however, not only can it change the physical appearance and create specific psychological effects, but it also causes various adverse effects in other parts of the body (20). It is worth mentioning that deviations from the optimal body condition lead to a loss of beauty and mechanical performance as well as makes the person prone to muscular nervous injuries (4, 9).

From the perspective of sports rehabilitation, which is responsible for prevention of athletes' injuries and promotion of their health, any disruption in the natural posture of the body is known as an abnormality and paves the way for the development of the next kinds of damage. It may lead to changes in the performance of individual skills (27). The findings of this study insist on the engagement of more serious attention on the part of coaches and athletes to the periodic assessment of posture and the angles, and the design of special corrective exercises appropriate to the needs of the athletes, if necessary.

APPLICABLE REMARKS

- It is suggested that more researches be conducted on the relationship between strength, endurance, and flexibility with the deformities of the spine in these athletes, to ensure better prescription of the corrective exercises.

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