THE RELATIONSHIP BETWEEN FLOOR EXERCISE LANDING DEDUCTION, ANTHROPOMETRIC CHARACTERISTICS AND BALANCE IN 6 TO 8 YEAR OLD GYMNASTS

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Abstract

Without doubt balance is one of a major effective aspect of appropriate sport skill performance (especially in Gymnastic). The purpose of this study was to investigate the relationship between floor exercise landing deduction, anthropometric characteristics and balance in twenty 6 to 8 year old gymnasts. For measuring balance: Stork test for static balance and Time to get up and go test for dynamic balance were used. To analyze the landing deduction in floor exercises, the floor routine were performed and recorded by video, and each landing deduction following each gymnastic element was evaluated. A total of 8 anthropometric variables were measured of each gymnast. A highly significant positive correlation was found between the landing deduction and dynamic balance ($r=0.807$; $p<0.01$) and highly significant negative correlation was found between landing deduction and static balance ($r=-0.862$; $p<0.01$). Significant negative correlation was found between dynamic balance and static balance ($r=-0.736$; $p<0.01$). Balance (static and dynamic) have important relation towards landing quality. Height, body weight, waist circumference, sole length and leg length are important characteristic in this age group. Also technical mastery is another factors that influence quality of landing.

Keywords: *gymnastics, male gymnasts, judging, succes.*

INTRODUCTION

Gymnastics is sport requires a high level of physical fitness factors such as strength, flexibility, agility, co-ordination, balance, and grace. It is a well-known exercise and sport in the world. An elite gymnast is supposed to be equipped with a combination of these motor features (Marinsek, 2009; Vandorpe, 2011). A gymnast for success and achieve to international level in gymnastic minimum needs ten years preparation and hard exercise (Marinsek, 2010; Markovic & Omrcen, 2010). This period of extensive preparation entails a long process of training covering special teaching methods to practice the moves with proper technique (Markovic & Omrcen, 2010). Today male gymnasts compete on Floor, Pommel Horse, Rings, Vault, Parallel Bars and High Bar apparatuses (FIG, 2009). Without doubt balance is one of a major effective aspect of appropriate sport skill performance (especially in Gymnastic) (Ashton-Miller, Wojtys, Huston, & Fry-Welch, 2001). Good gymnasts must maintain balances in order to successfully perform the dynamic and static acrobatic moves at different levels. Thus, during the special training period, posture

control exercises should be particularly emphasized (Vuillerme & Nougier, 2004). For performing acrobatic gymnastic elements, gymnasts have to immediately transfer their body's weight from one position to another (Asseman, Caron, & Cremieux, 2004). Therefore, gymnasts practice special training methods by using their own body weights. These exercises consist of the move itself or similar but modified moves (Halilaj & Vehapi, 2009). In the process of learning a move, repetitions over a long period of time also serve as special strength exercises, which help to increase the gymnast's strength and stamina (Jemni, Sands, Friemel, Stone, & Cooke, 2006). Practicing various training techniques improves the gymnast's ability to control his body position in the air during somersault moves and ability to stand in landing. As the number of somersaults increases, the angular momentum in the transversal axis will also increase and make it harder for the gymnast to keep his balance in landing (Suchilin & Arkaev, 2004). The gymnast`s total effort lasts for 12-15 minutes including warm-ups. The gymnast has to perform his skills in such a short time by applying maximum strength, agility and ability (Halilaj & Vehapi, 2009; Jemni, Sands, Friemel, Stone, & Cooke, 2006). In the evaluation of the performances by the judges during the competition, the gymnast is expected to achieve a goal special requirements for each apparatus. In this complex structure, the male gymnasts are expected to perform a series of moves in all 6 apparatuses. These series of moves consist of simple and complex skills following one another consecutively (Bruggemann, 1994; FIG, 2012). Code of point (COP) is regulation of international Gymnastics federation for gymnasts, coaches and judges. According the code of point, a floor exercise has to be completed in 70 seconds (Bruggemann, 1994). Thus, the energy system for a floor exercise is anaerobic energy system, because floor routine consist of acrobatic moves of short duration and high intensity. Judges evaluate each gymnast elements with base on regulation in code of point to mastery in technical skills (Bruggemann, 1994), comparison of different techniques (Franks, 1993, Yoshiaki, Dunn; & Blucker, 2003) and defects in execution (FIG, 2012). Except rolling elements, each acrobatic element in floor exercises must end in a perfect standing position (FIG, 2012). Any deviation from the correct position is considered as mistakes and the judges made deduction according code of point (COP). In landing from the twisting and somersault elements consisting of acrobatic skills, the primary purpose is to be able to stop the linear and angular movement effectively at the moment of contacting the floor. Professional gymnasts shows the control and well landing, because they have good technic and sufficient height, but mistakes in technical execution and insufficient height can affect the balance in landing negatively (McNitt-Gray, Requejo, Costa, & Mathiyakom, 2001).

General balance ability is vital for both obtain and controlling the motor skills. Even if this skill may be a genetic characteristic of the person, it is said that it can be improved by training (Polishchuc & Mosakowska, 2007). The speed and the level of learning the technical skills in sports are closely associated with balance ability. According to study and researches athletes specially gymnasts have better static and dynamic balance ability than people who are not involved in sports and are untrained people, and the balance ability improve in tandem with the number of years spent in sports (Paillard et al., 2006). Extra to this, posture control is thought to be related to the kind of activity undertaken (Asseman, Caron, & Cremieux, 2004). Studies indicates that gymnastic exercises enhance the balance ability (Kruczkowski, 2007, Vuillerme, Teasdale, & Nougier, 2001). For example the men have an event that requires extraordinary balance abilities-pommel horse. Of course, handstands are probably the single most recognized balance skills. The still rings in men's gymnastics is an underrated balance event which requires the gymnast to continuously keep the

movable rings under himself. Gymnasts learn to balance on their feet and their hands. Interestingly, gymnasts tend to develop a higher tolerance for imbalance or disturbances to their balance. Gymnasts do not react with as large a "startle response" to sudden imbalances as non-gymnasts. This probably means that gymnasts can tolerate larger disturbances to their posture because they have become more familiar with these positions and do not consider them to be such a threat (Bosco, 1973; Debu, Woollacott, 1988; Kioumourtzoglou, Derri, Mertzanidou, & Tzetzis, 1997). However, there are some studies comparing landing in floor exercise with balancing skills (Marinsek, 2009; Markovic & Omrcen, 2010; Marinsek & Čuk 2013; Čuk & Marinšek 2013).

Starting from this fact, the purpose of this study is the relationship between floor exercise landing deduction, anthropometric characteristics and balance in 6 to 8 year old gymnasts.

METHODS

Twenty gymnasts in age group 6 to 8 competition in Ardebil choose to participate in this study. Participants were excluded if they had an abnormalities, general health problems, vestibular problems, visual problems, or a concussion before the study. Before testing began, the aim and procedures of the study were explained to the participants and informed consent was obtained. A total of 8 anthropometric variables (heights, body weights, length: total hand, total leg, sole, Circumference: calf, waist, hips) were recorded of each subject on right sides of body on the day before the competition. The study was performed during competitive season. Subjects were restrained from fatiguing exercise before test days. The limb dominance was determined by asking the participant which leg he preferred for doing handstand. During the competition, starting and resulting scores, and deductions made by the jury for the floor exercise performances of the gymnasts were recorded. Floor exercise routines were also recorded by a camera in order to analyze the landing deduction. The performances of the recorded gymnasts were watched and evaluated once again by six International Iranian Judges only for landing deductions no other deductions like technical deductions.

The following anthropometric instruments were used:

Seca 220R telescopic stadiometer (measuring range: 85-200cm; precision: 1mm). Seca 710R weighing scale, calibrated beforehand (capacity: 200kg; precision: 50g). Anthropometric tape (precision: 1mm). Sliding Caliper (precision: 1mm). Additional equipment (a wax pencil for marking the individual, a spirit level to ensure the correct alignment of the anthropometry).

Balance performance of the participants was assessed with the aid of the SEBT (Stork balance stand test) (Johnson & Nelson 2009). (This test measures the ability of the participant to balance on the ball of the foot with hands placed on the hips while positioning the non-supporting foot against the inside knee of the supporting leg. Afterwards, the gymnasts were given one trial. Using a stopwatch, the amount of time in seconds that the participant is able to stand on the ball of the foot of one leg is indicative of his balance performance. The timing is stopped if:

(i) The supporting foot swivels or moves (hops) in any direction. (ii) The non-supporting foot loses contact with the knee. (iii) The heel of the supporting foot touches the floor. Since, time is increasing in this test, participant obtain higher score in the higher duration. For each participant, the overall score was the best of three attempts. The same procedure was carried out for both lower limbs.

For Evaluating of the dynamic balance we used the Timed Up & Go Test (TUG). The TUG test was developed as a brief screen for mobility and falls risk. It has good test-retest reliability and sensitivity and specificity for falls. The TUG test measures, in seconds, the time it takes for an

individual to stand up from a standard arm chair, walk a distance of 3 meters (9.84 feet), turn, walk back to the chair, and sit down again. The participant wears his gymnastics footwear. No physical assistance is given. Participants start with their back against the chair, their arms resting on the armrests, and their walking aid at hand if needed. When I say "go" I'd like you to stand up and walk as quickly as safely as possible to that line on the floor, turn, return to the chair, and sit down again. Have the participant practice one trial to be sure they understand the procedure. Start timing when you say go and stop when the participant sits down.

Use a stop-watch to time the performance and observe balance closely, especially at the turn. If the participant does not perform the test correctly the first time (stops at the turn, does not sit down right away, or does not walk all of the way to the 3 meter mark) repeat the test. Since, time is decreasing in this test, participant obtain higher score in the lower duration.

Process of evaluating floor exercise was simple and according regularly of code of point (COP). Floor exercise program for athletes were Optional. In artistic gymnastics competition two separates scores, "D" and "E", will be calculated on all apparatus. The D-jury establishes the "D" score, the content of an exercise, and the E-jury the "E" score, the exercise presentation related to compositional requirements, technique and body position. According the code of point "E" jury for any small LD (landing deduction) and Poor posture or body position or postural corrections in end positions considered (0.10), medium (0.30), and major (0.50) errors. In line with the purpose of the study, a jury of six International Iranian Judges was formed to detect the LD in floor routines. Keeping in mind the deductions made by the "E" jury and score given by the head judge "D" jury during the competition, these judges watched the recorded routines once again. In this study in conformity with the international code of points, errors in balance was penalized as small (0.10), medium (0.30), and major (0.50) faults. Mistakes in landing due to insufficient height or poor technique in the execution of a skill were not taken into account.

In ferential and descriptive statistics and relationship between, static and dynamic balance, LD and age, height, body weight, lengths of total hand, leg and sole, circumferences of calf and waist were investigate by using multiple correlations. The level of statistical significance was set to $p \leq 0.05$. The statistical analyses were done by using statistical software (SPSS version 19.0).

RESULTS

According Kolmogorov Smirnov test distribution of variables were normal. More detailed information (means and standard deviations) about gymnasts are reported in table 1.

All collected data were analyzed using Pearson Correlation Coefficient shown in table 2 and 3.

Result showed that there was a negative correlation between LD and sole length ($r=-0.542$; $p<0.05$) and A highly significant positive correlation was found between leg length ($r=0.866$; $p<0.05$) and positive correlation between height ($r=0.670$; $p<0.05$). In dynamic balance (DB) there was a negative correlation between body weight ($r=-0.529$; $p<0.05$) and sole length ($r=-0.551$; $p<0.05$). Also we found positive correlation between height ($r=0.784$; $p<0.05$) and leg length ($r=0.684$; $p<0.05$). In SB we observed highly negative correlation between height ($r=-0.807$; $p<0.05$) and leg length ($r=-0.710$; $p<0.05$) and positive correlation between body weight ($r=0.784$; $p<0.05$), waist circumference ($r=0.606$; $p<0.05$), total hand length ($r=0.575$; $p<0.05$). There was not found any statistically significant correlation between LD and age, training history, body weight, Calf circumference, waist circumference and total hand length ($p>0.05$). No correlation was found between DB and age, training history, Calf circumference ($p>0.05$). Also not found any correlation

between SB and age, training history ($p>0.05$). Correlation between floor exercise evaluations and balance tests was assessed with Pearson Correlation coefficient, shown as correlation matrix in table 4.

A highly significant positive correlation was found between the LD and DB ($r=0.807$; $p<0.01$) and highly significant negative correlation was found between LD and SB ($r=-0.862$; $p<0.01$). Significant negative correlation was found between DB and SB ($r=-0.736$; $p<0.01$).

Table 1
Means and Standard Deviation of the gymnasts.

Variables	Mean	SD
Age (Year)	6.85	.745
Training history (years)	2.75	.638
Height (cm)	118.80	5.836
Weight (kg)	22.35	2.967
Calf circumference	23.30	3.514
Waist circumference	54.32	3.514
total hand length	54.35	2.763
sole length	18.62	.930
Leg length (cm)	66.27	3.871
Static Balance(SB)	3.79	1.496
Dynamic Balance(DB)	5.68	.478
Landing Deduction (LD)	.72	.168

Table 2
Pearson correlation between balance and landing deduction and some anthropometric variables.

Variables	Landing deduction (LD)	Dynamic Balance (DB)	Static Balance (SB)
Age (Year)	-.388	-.048	.353
Training history (year)	-.135	.176	.034
Height (cm)	.670*	.784*	-.807*
Body weight (kg)	-.254	-.529*	.784*
Calf circumference (cm)	-.471	-.370	.464
Waist circumference (cm)	-.540	-.534*	.606*
Total hand length(cm)	-.569	-.493	.575*
Sole length (cm)	-.542*	-.551*	.468
Leg length (cm)	.866*	.684*	-.710*

*Correlation is significant at the 0.05 level.

Table 3.
Pearson correlation matrix for Landing deduction and Dynamic Balance and Static Balance.

Variables	Landing deduction (LD)	Dynamic Balance (DB)	Static Balance (SB)
Landing deduction (LD)	1	.807**	-.862**
Dynamic Balance (DB)		1	-.736**
Static Balance (SB)			1

**. Correlation is significant at the 0.01 level.

DISCUSSION

The purpose of this study is the relationship between floor exercise landing deduction, anthropometric characteristics and balance in 6 to 8 year old gymnasts. In LD we found a negative correlation between SB, Sole length and positive correlation between heights, leg lengths. According to the result we can say a gymnast that have good SB, long sole length, short leg length and height will have low deduction in landing and better control in landing. In DB we observed a negative correlation between SB, waist circumference, sole length, body weight and positive correlation between heights, leg length. According to the result we can say a gymnast that have good SB, more waist circumference, long sole length and low height, leg length will have low deduction in landing and better control in landing. In SB we observed negative correlation between height, leg length and positive correlation between body weight, waist circumference, and total hand length. According to the result we can say when gymnast have short height, leg length and approximately high body weight, more waist circumference and long total hand length will have better control in landing and low LD. Measuring DB in high level athletes (Davlin, 2004) found negative correlation between DB performance and height and weight. Our study found correlation between the length of some body parts and LD during floor routines of the 6 to 8 years old age group of Iranian federation gymnastic program. Among the population of the competing gymnasts, physical performance special to gymnastics, general motor coordination and high level skills are the most important values in determining the profile of the talented gymnast (Suchilin & Arkaev, 2004). When the gymnasts want to land, some anthropometric characteristics played important role in maintaining balance and reducing deduction. Short height is considered an advantage in gymnastic because a shorter person's center of gravity is closer to the gravity than that of taller gymnasts and he can overcome the resistance applied by his feet to the floor and reaction resistance of the floor more easily by muscle strength and coordination (Lohman, Roche, & Martorell, 1998). Study indicated that only 1 gymnast out of 20 did not make any mistake in dismount moves in parallel bar and horizontal bar routines in1996 Olympics (McNitt-Gray, Requejo, Costa, & Mathiyakom, 2001). In performing acrobatic elements, a gymnast can make mistakes at any phase of the move. These phases are interrelated, and it is stated that a mistake in the first stage of the move can affect the final stage and thus the balance in landing (Markovic & Omrcen, 2010; Suchilin & Arkaev, 2004). There are dismounts in all of the gymnastics apparatuses. Controlling balance and landing without deduction plays important role for getting high score. In artistic gymnastics, on the other hand, the force applied to the floor is very high during the moment of take off and landing. It is pointed out that force applied to the floor during landing is 3.9 to 14.4 times greater than the gymnast's body weight (Marinsek, 2010; McNitt-Gray, Requejo, Costa, & Mathiyakom, 2001). The goal in landing is to absorb on the floor the energy produced by the body during the flight period in the air. The gymnast has to figure out during the flight period how to orient the direction and the amount of energy in his landing. The direction of the kinetic energy can be diverted as the gymnast contacts the floor in landing or the kinetic energy can be reduced by slowing down the move during the flight in the air (Marinsek, 2009). There are many factors and variables that cause the gymnast's success in control of his standing against the reaction force of the floor during the landing, like the gymnast's muscle coordination, and some anthropometry characteristics like body weight, height and ability to conquer the impact at the moment of contacting the floor (Marinsek, 2010; McNitt-Gray, Requejo, Costa, &

Mathiyakom, 2001). According code of point (COP) and gymnastics rules there are various deduction in gymnastics. One of them is related to LD. When the gymnast cannot control his balance in landing, judges consider deduct for the gymnast. Therefore, maintaining one's balance are an important factor in taking the high score. Sufficient height of the somersault and elements is vital for a successful landing. If a gymnast have sufficient height in somersault, he will be more time to do his element and will have enough landing phase to prepare himself for the landing, and the probability of making mistakes in landing will decrease (Marinsek, 2009). In this study we did not consider the deduction in balance due to problems related to insufficient height and poor technique.

CONCLUSION

The result of study point out correlation between SB, DB parameters LD and some anthropometric characteristics. Balance (static and dynamic) have important relation towards landing quality. Both tests are directly related with better balance we will have better landing. In anthropometric characteristics height, body weight, Waist circumference, Sole length and leg length are important in this age group. Also technical mastery is another factors that influence on better landing. We suggest to researches to do this study in other age group and do with girls gymnastic and use development of test batteries that are more sensitive to the technical characteristics specific to gymnastics. At the end we suggest to couches for decrease their gymnastics deductions and taking high score, notice to athletes' balance performance and some anthropometry characteristics and train their athletes with balance exercise to have good landing.

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