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Assessment and determinants of lumbar flexibility in athlete and non-athlete university undergraduates

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Abstract. *Introduction.* Reference database for lumbar spine range of motion (ROM) may serve as rehabilitation outcome tool and also help to recognize decreased spinal ROM that may impede sport participation and performance in athletes. This study aimed to establish normative values and determinants of lumbar spinal ROM in athletes and non-athletes undergraduates. *Materials and Methods.* 240 (120 athletes and 120 non-athletes) university undergraduates whose ages ranged between 18 and 37 years volunteered for the study. The athlete group were recruited from the judo, taekwondo, football and basketball teams of the university. Dual inclinometric technique was used to measure spinal ROM in forward flexion (FF), extension (Ext), right lateral flexion (RLF) and left lateral flexion (LLF). Data was analyzed using descriptive and inferential statistics at 0.05 alpha level. *Results*. The athletes and non-athletes were comparable in age ($p=0.787$). The mean value for FF, Ext, RLF and LLF was 49.4±11.3˚, 19.8±9.51˚, 18.0±10.8˚ for athletes and 17.7±5.25˚; and 40.7±13.12˚, 15.7±8.04˚, 18.3±7.26˚ and 15.5±5.17˚ for non-athletes respectively. Athletes had significantly higher FF, Ext and LLF ($p<0.05$). Spinal ROMs were higher among female athletes and non-athletes compared with their male counterparts ($p<0.05$). There was a significant difference in FF ($p=0.009$) and LLF ($p=0.010$) among the different sport types. Significant correlations were found between limb length and each of FF ($r = -0.338$, $p = 0.001$) and Ext ($r = -0.248$, $p = 0.006$) among athletes, while there was a significant correlation between FF and body weight ($r = 0.605$, $p = 0.040$) among non-athletes. *Conclusion.* Lumbar spine flexibility was significantly greater in athletes than non-athletes. Both athlete and non-athlete females had higher lumbar spine flexibility than their male counterparts. Degree of forward and left lateral flexion seems to have sport-specific propensity. Limb length and body weight were determinants of lumbar spine flexibility.

Key words: *athletes, dual inclinometer, non-athletes, normative data, spinal flexibility*.

Introduction

Assessment of lumbar spine flexibility aids in determining level of spinal pathology, choice of treatment and in knowing patient response to treatment (1, 2). In order to adequately manage impairment resulting from loss of spinal flexibility, objective examination of spinal range of motion (ROM) is essential in planning and assessing treatment progress (3). Any structural or functional impairment in the extremity can be recognized by comparing the affected extremity with the unaffected but such inherent control is not obtainable in health-related physical performance evaluation of the trunk (4, 5). Consequently, comparing the flexibility test result of patients with reference data of healthy subjects may help identify the extent of impairment and also serve as a benchmark for rehabilitation. However, lack of reference values is a major limitation in the assessment of lumbar spine flexibility. Therefore, normative data for lumbar spine ROM using valid and reliable measurement techniques are important. Clinical measurement methods and techniques for assessing spinal ROM include visual estimation (6, 7), finger-to-floor distance (8), sit-and-reach measurements (9,10), standard or modified Schober methods (8, 11), the use of devices such as flexicurves (12, 13), protractors and goniometers (14, 15) and inclinometers (16-19). The lumbar spine ROM assessment techniques and tools that were used in most previous studies are believed to be impracticable and not feasible for clinical use. The American Medical Association (AMA) Guides specifically recommend the use of an inclinometer as the preferred device for measuring lumbar spine ROM (20).

The inclinometric technique has been found to be valid and reliable; and could measure and differentiate movements of the hip from those of the lumbar spine (6, 16, 19, 20).

Flexibility of the lumbar spine is influenced by many factors which may exhibit mutual association with each other.

Significant relationships have been reported between spinal ROM and each of age (14, 21-23), gender (21-23), occupation (24, 25), specific time of day because of loss of height of the inter-vertebral discs (26), racial and population differences (27, 28), presence of lumbar pain (29, 30) and participation in sports (31, 32).

Trudelle-Jackson et al (28) summarized that spinal ROM varies with age, gender, and possibly race/ethnicity, but adequate normative values for different age and racial/ethnic groups do not exist. Furthermore, database on spinal ROM in apparently healthy individuals may not be extrapolated to the athletic population.

This study aimed to establish normative values and determinants of lumbar spinal flexibility in athlete and non athlete undergraduates from a Nigerian university.

Material and Method

A total of 240 (120 athletes and 120 non-athletes) individuals aged between 18 and 37 years were recruited for this study.

The ethical approval for the study was obtained from the Obafemi Awolowo University Teaching Hospitals Complex Ethics and Research Committee. The athlete group were recruited from the judo, taekwondo, football and basketball teams of the university.

A consenting individual was considered to be an athlete if he/she practiced a sporting activity regularly, consisting of a minimum of six hours of training per week.

An individual was considered to be a non-athlete if he/she did not regularly practice any sporting activity.

Both athletes and non-athletes were students recruited largely from the departments of Physical and Health Education and Medical Rehabilitation at the Obafemi Awolowo University (OAU), Ile-Ife, Nigeria.

Participants were screened via interview to ensure that they satisfied the selection criteria for the study. Exclusion criteria were a history of asymptomatic LBP for a minimum of 6 months as at the time of the study, any obvious spinal deformity or neurological disease, any evidence of pregnancy, any disability limiting the capacity to exercise and a history of cardiovascular diseases contraindicating to exercise.

The study was carried out at the gymnasium of the department of Physical and Health Education, OAU.

Anthropometric measurements taken from all participants included height, weight, body mass index (BMI), limb length (LL) and trunk length (TL).

Height was measured to the nearest 0.1cm with a height meter (Seca Model 220 CE, Germany). The participant stood barefooted on the platform of the scale looking straight ahead while the horizontal bar attached to the height meter was adjusted to touch the vertex of the head.

Weight was measured nearest to the 0.1Kg on a weighing scale (Seca Model 7621019009 C€, Vogel & Halke, Germany) with the participant in minimal clothing, barefoot and standing in an erect posture looking straight ahead.

LL was measured by taking the distance between the anterior superior iliac spine and the sole of the foot with the participant in an erect position.

TL was measured by taking the distance from the anterior superior iliac spine to the acromion process with the participant in an erect position. BMI was calculated by dividing weight in kilograms by height in metres squared.

Dual inclinometric technique was used in the assessment of lumbar spine ROM in flexion, extension, right and left lateral flexion. The assessment procedure was explained and demonstrated to each consecutive participant at inclusion. Prior to the test, the participants were asked to warm up for 3 minutes by stretching their backs and hamstrings before the commencement of the measurements.

Measurements were carried out with the universal inclinometer (AMP model 031434, Delhi India) calibrated from 0 to 360 degrees following the guidelines provided in the American Medical Association (AMA) Guides (20). The mean of three consecutive movements was used in the final analysis to determine lumbar spine ROM.

Forward flexion and extension measurement. The upper edge of the sacrum (S1 vertebra) and the lower edge of the T12 vertebra were palpated on the participants in a standing position. The middle of the platform of the first inclinometer was placed on the sagittal plane of the spinous process of T12, and the second inclinometer placed on the sagittal plane of the spinous process of S1 and lumbar range of motion (LROM) was determined

in degrees using the technique described by Loebl (33).
In neutral position, the participants were asked to stand erect with their hands hanging without any effort toward the ground and the inclinometers zeroed. From this position, the participants were then asked to flex forward as far as possible with their knees straight.
The readings on the two inclinometers were taken. The reading on the first inclinometer was the total lumbar flexion and that on the second inclinometer, the total sacral flexion. To get the true LROM, the reading of the lower inclinometer was subtracted from that of the upper inclinometer.
The flexion protocol was repeated for extension by having the participants extend back for full extension instead of flexing forward. The readings were taken.
The procedure was performed three times for both forward flexion and extension (6, 20).
Lateral flexion measurement. The inclinometers were placed next on the frontal planes of the both the S1 and T12 vertebrae so that the bases of the inclinometers line up with the lines drawn at these planes. The T12 inclinometer was held upside down and not pressed against the back, so that the gravity dependent pendulum swings freely. The two inclinometers were then zeroed.
The participants were then asked to stand erect facing a wall with nose nearly touching the wall. This position kept the participants from bending forward during lateral flexion measurements. The participants were asked to laterally flex to the right by running their right hands down the lateral thigh towards the right knee. The readings were then taken from the two inclinometers.
The difference between the T12 and the S1 inclinometers gave the true right lateral flexion value. The right lateral flexion procedure was repeated for left lateral flexion by having the participants bend left instead of bending to the right. The readings were taken again. The procedure was performed three times for both left and right lateral flexions (6, 20).
*Data analysis. D*ata were summarized using the descriptive statistics of mean and standard deviation. Inferential statistics of Independent t-test, One-Way Analysis of Variance (ANOVA) and Pearson's product moment correlation analysis were used. The alpha level was set at 0.05. The data analysis was carried out using SPSS 16.0 version software (SPSS Inc., Chicago, Illinois, USA).

Results
The mean age of all the participants was 22.8±2.85years. Comparison of the general characteristics between athletes and non-athletes is presented in table I. Both groups were comparable in their physical characteristics (p>0.05) except for significant higher height (p=0.009) and limb length (p=0.007) among the athletes.
Table II presents the independent t-test comparison of the spinal flexibility between athletes and non-athletes. There was no significant difference between right lateral flexion of athletes and non-athletes (p>0.05). However, significant differences were observed in the forward flexion (p=0.001), extension (p=0.001) and left lateral flexion (p=0.004) between athletes and non-athletes. The summary of the One-way ANOVA comparing the physical characteristics and lumbar spine ROMs across different sport types is presented in table III. There were significant differences in the physical characteristics compared by sport types. There was however significant difference in forward flexion (p=0.009) and left lateral flexion (p=0.010) among the different sport types. The mean scores and percentile data for spinal flexibility of non-athletes and athletes are presented in tables IV and V respectively. Percentile cut-points were used to define flexibility scores as poor (less than 25th percentile), medium (scores between 25th and 75th percentile), high (scores between 75th and (95th percentile) and very high (greater than 95th percentile). Table VI presents the Pearson's correlation between lumbar spine flexibility of athletes and the individual factors. Significant correlations were found between limb length and each of forward flexion (r = -0.338, p = 0.001) and extension and (r = -0.248, p = 0.006). There was also a direct correlation between extension and right lateral flexion (r = 0.321, p = 0.001)
Table VII presents Pearson's correlation between lumbar spine flexibility of non-athletes and the individual factors. There was a significant direct correlation between forward flexion and weight (r = 0.605, p = 0.040). Extension was significantly correlated with each of forward flexion (r = 0.184, p = 0.044) and right lateral flexion (r = 0.276, p = 0.002). Right lateral flexion also correlated weakly with left lateral flexion (r = 0.385, p = 0.001). Left lateral flexion correlated negatively with height (r = -0.248, p = 0.006) and limb length (r = -0.198, p = 0.03) respectively.

Table I. Independent t-test comparison of the general characteristics between athletes and non-athletes

Variables	Athletes (n=120) X ±S.D	Non-athletes (n=120) X ±S.D	t	p-value
Age (yrs)	22.7±2.87	22.9±4.18	0.270	0.787
Weight (kg)	67.8±10.44	65.1±13.39	-1.720	0.087
BMI (kg/m^2)	23.0±5.16	22.9±4.89	-1.58	0.875
Trunk length (m)	0.7±0.07	0.7±0.07	-1.141	0.255
Limb length (m)	1.0±0.07	1.0±0.077	-2.731	0.007*
Height (m)	1.7±0.11	1.7±0.10	-2.624	0.009*

Key: BMI = Body Mass Index; * p is significant at ≤ 0.05

Table II. Independent t-test comparison of spinal flexibility between athletes and non-athletes

Variables	Athletes (n=120) X ±S.D	Non-athletes (n=120) X ±S.D	t	p-value
FF (˚)	49.4+11.31	40.7+13.12	-5.480	0.001*
EXT (˚)	19.8+9.51	15.7+8.04	-3.627	0.001*
RLF (˚)	18.0+10.81	18.3+7.26	0.201	0.841
LLF (˚)	17.7+5.25	15.5+6.17	-2.917	0.004*

Key: FF = Forward Flexion; EXT = Extension; RLF = Right Lateral Flexion;
LLF = Left Lateral Flexion, (˚) = degrees; * p is significant at ≤ 0.05

Table III. One-Way ANOVA and Post-Hoc LSD comparison of general characteristics and spinal flexibility according to sport type

Variables	Judo N = 30 X ±S.D	Football N = 30 X ±S.D	Basketball N = 30 X ±S.D	Taekwondo N = 30 X ±S.D	F-ratio	p-value
Age (yr)	23.2 ± 3.26	22.9 ± 2.98	22.9 ± 3.14	21.9 ± 1.86	1.194	0.315
Weight (kg)	70.0 ± 11.83[a]	67.8 ± 7.10 [a]	73.3 ± 9.93[b]	63.0 ± 10.11[c]	5.556	0.001*
BMI (kg/m^2)	23.3 ± 4.22	22.6 ± 2.30	24.2 ± 8.74	22.1 ± 2.67	0.923	0.432
Trunk length (m)	0.7 ± 0.05	0.7 ± 0.09	0.7 ± 0.14	0.7 ± 0.04	1.141	0.336
Limb length (m)	1.0 ± 0.05[a]	1.0 ± 0.06[a]	1.1 ± 0.07[b]	1.0 ± 0.05[a]	8.174	0.001*
Height (m)	1.7 ± 0.09	1.7 ± 0.06	1.8 ± 0.17	1.7 ± 0.08	3.994	0.010*
FF (˚)	53.7 ± 12.13[a]	50.0 ± 9.19 [b]	44.1 ± 10.89[c]	49.9 ± 11.18[b]	4.005	0.009*
EXT (˚)	19.7 ± 11.77	19.4 ± 8.65	17.7 ± 7.35	22.5 ± 9.59	1.329	0.268
RLF (˚)	18.4 ± 5.83	17.7 ± 19.08	16.3 ± 4.86	19.8 ± 7.14	0.535	0.659
LLF (˚)	16.5 ± 5.61[a]	17.6 ± 4.32[a]	16.4 ± 4.86[a]	20.3 ± 5.38[b]	3.947	0.010*

* p is significant at ≤ 0.05. Superscripts ([a,b,c])
For a particular variable, mode means with different superscript are significantly (p<0.05) different. Mode means with same superscripts are not significantly (p>0.05) different. The pair of cell means that is significant has different superscripts.

Table IV. Baseline mean score and percentile data of spinal flexibility of non-athletes

	Gender	N	X ± S.D	minimum	25th percentile	median	75thpercentile	95th percentile	maximum
FF	M	59	38.9 ± 11.70	18.67	30.00	38.33	46.67	59.67	65.00
	F	61	14.74 ± 14.21	11.67	30.67	43.00	53.17	63.64	71.67
	(M +F)	120	40.7 ± 13.12	11.67	30.00	40.00	50.83	62.00	71.67
EXT	M	59	14.74 ± 9.52	3.67	9.00	12.00	17.67	32.67	66.00
	F	61	16.7 ± 6.21	4.67	12.67	15.33	21.00	29.10	34.33
	(M+F)	120	15.7 ± 8.04	3.67	10.33	14.33	19.83	30.60	66.00
RLF	M	59	16.6 ± 7.90	4.67	10.33	15.33	21.67	29.00	52.00
	F	61	19.9 ± 6.23	6.67	16.17	20.00	24.50	29.97	33.00
	(M+F)	120	18.3 ± 7.26	4.67	12.84	18.33	22.33	29.67	52.00
LLF	M	59	14.2 ± 5.08	2.00	10.33	14.33	17.67	22.00	22.35
	F	61	16.9 ± 6.85	4.00	12.33	15.67	21.34	31.40	37.33
	(M+F)	120	15.5 ± 6.17	2.00	11.42	15.00	19.67	26.26	37.33

Key: FF = Forward Flexion; EXT = Extension; RLF = Right Lateral Flexion; LLF = Left Lateral Flexion; BMI = Body Mass Index; G = Gender; M = Male; F = Female

Table V. Baseline mean score and percentile data of spinal flexion of athletes

	Gender	N	X ±S.D	Minimum	25th percentile	Median	75th percentile	95th percentile	Maximum
FF									
	M	87	48.5 ± 12.03	16.67	42.00	47.67	56.00	72.13	78.67
	F	33	51.9 ± 8.85	37.67	45.50	50.00	58.33	71.43	71.67
	M+F	120	49.4 ± 11.31	16.67	42.50	48.67	56.92	71.23	78.67
EXT									
	M	87	18.7 ± 7.92	5.33	12.33	17.67	22.00	35.07	42.67
	F	33	22.8 ± 12.48	8.33	14.00	20.67	28.50	51.03	69.00
	M+F	120	19.8 ± 9.52	5.33	13.08	18.33	23.50	39.16	69.00
RLF									
	M	87	17.2 ± 11.76	4.67	12.67	16.33	19.67	25.93	115.00
	F	33	20.3 ± 7.43	7.00	14.67	20.33	24.00	36.23	38.33
	M+F	120	18.0 ± 10.81	4.67	12.67	16.67	21.00	29.60	115.00
LLF	M	87	18.6 ± 4.78	5.00	16.00	18.84	22.33	26.00	29.67
	F	33	15.4 ± 5.76	3.00	11.00	14.23	19.67	27.77	30.33
	M+F	120	17.7 ± 5.25	3.00	13.33	18.00	21.00	26.00	30.33

Key: FF = Forward Flexion; EXT = Extension; RLF = Right Lateral Flexion; LLF = Left Lateral Flexion;
BMI = Body Mass Index; G = Gender; M = Male, F = Female

Table VI. Correlation matrix between lumbar spine flexibility of athletes and individual factors

	Age (yrs)	Wt (kg)	TL (m)	Ht (m)	B MI (kg/m^2)	LL (m)	FF (˚)	EXT (˚)	RLF (˚)	LLF (˚)
Age	1.000									
Wt	0.260*	1.000								
	0.004									
TL	0.201*	0.285*	1.000							
	0.028	0.002								
Ht	0.141	0.456*	0.821*	1.000						
	0.124	0.001	0.001							
BMI	0.056	0.453*	-0.639*	-0.527*	1.000					
	0.541	0.001	0.001	0.001						
LL	0.003	0.440*	0.216*	0.734	-0.143	1.000				
	0.975	0.001	0.018	0.001	0.120					
FF	-0.002	-0.150	-0.004	-0.200	-0.032	-0.338*	1.000			
	0.983	0.103	0.969	0.028	0.731	0.001				
EXT	-0.093	-0.011	-0.093	-0.029*	0.113	-0.248*	0.142	1.000		
	0.312	0.908	0.315	0.022	0.220	0.006	0.122			
RLF	-0.041	-0.122	-0.081	-0.090	-0.040	-0.058	-0.024	0.321*	1.000	
	0.656	0.184	0.380	0.326	0.866	0.526	0.792	0.001		
LLF	0.023	0.104	-0.055	0.001	0.118	0.065	-0.116	0.153	0.099	1.000
	0.804	0.106	0.554	0.999	0.202	0.481	0.207	0.096	0.282	

Wt- weight; TL- trunk length; Ht- height; LL- limb length; FF- forward flexion; Ext- extension; RLF- right lateral flexion;
LLF- left lateral flexion; * p is significant at ≤ 0.05

Table VII. Correlation matrix between lumbar spine flexibility of non-athletes and individual factors

	Age (yrs)	Wt (kg)	TL (m)	Ht (m)	BMI (kg/m^2)	LL (m)	FF (˚)	EXT (˚)	RLF (˚)	LLF (˚)
Age	1.000									
Wt	0.260*	1.000	0.004							
TL	0.201*	0.285*	1.000	0.028	0.002					
Ht	0.141	0.456*	0.821*	1.000	0.124	0.001	0.001			
BMI	0.056	0.453*	-0.639*	-0.527*	1.000	0.541	0.001	0.001	0.001	
LL	0.003	0.440*	0.216*	0.734	-0.143	1.000				
	0.975	0.001	0.018	0.001	0.120					
FF	-0.002	-0.150	-0.004	-0.200	-0.032	-0.338*	1.000			
	0.983	0.103	0.969	0.028	0.731	0.001				
EXT	-0.093	-0.011	-0.093	-0.029*	0.113	-0.248*	0.142	1.000		
	0.312	0.908	0.315	0.022	0.220	0.006	0.122			
RLF	-0.041	-0.122	-0.081	-0.090	-0.040	-0.058	-0.024	0.321*	1.000	
	0.656	0.184	0.380	0.326	0.866	0.526	0.792	0.001		
LLF	0.023	0.104	-0.055	0.001	0.118	0.065	-0.116	0.153	0.099	1.000
	0.804	0.106	0.554	0.999	0.202	0.481	0.207	0.096	0.282	

Key: Wt- weight; TL- trunk length; Ht- height; BMI- body mass index; LL-limb length; FF- forward flexion; EXT- extension; RLF- right lateral flexion; LLF- left lateral flexion; * p is significant at ≤ 0.05

Discussion

This study established normative values and determinants of lumbar spinal flexibility in athlete and non-athlete undergraduates from a Nigerian university. The non-athletes had mean values of 40.7±13.12˚, 15.7±8.04˚, 18.3±7.26˚ and 15.5±5.17˚ for forward flexion, extension, right lateral flexion and left lateral flexion respectively. These values are within the range of 40-60˚, 20-35˚ and 3-18˚ for forward, extension, left and right lateral flexions proposed by Magee (34) for apparently healthy individuals. On the other hand, the athletes had mean values of 49.4±11.3˚, 19.8±9.51˚, 18.0±10.8˚ and 17.7±5.25˚ for forward flexion, extension, right lateral flexion and left lateral flexion respectively. The results of this study indicate that athletes had higher lumbar spine flexibility values than non-athletes. Therefore, normative data on lumbar spinal flexibility among apparently healthy individuals may not be suitable as reference data in the rehabilitation of athletes with spinal impairments. Mbada et al (5) submitted that empirical data on trunk strength and spinal mobility in healthy athletes may help identify those athletes at risk for future injury, to predict physical performance capabilities, pre-participation physical assessment and in monitoring rehabilitation outcomes. However, only few studies have documented normative values for lumbar spinal ROM in athletes (31, 32, 35). Chertman et al (35) in a study on lumbar range of movement in healthy athletes and non-athletes reported that individuals who practice sports present higher values in trunk flexion than non-athletes. Furthermore, Strong and Titlow (36) found better sagittal back motion in athletes compared with non-athletes.

From this study, significant differences were found in forward and left lateral flexion among participants in different sports. Higher forward flexion was found among Judo practitioners while basketball players had the least forward flexion values. On the other hand, taekwondo practitioners had higher left lateral flexion compared with judokas, footballers and basketball players respectively. Athletes in different sports are reported to have varying flexibility profiles and thus varying flexibility needs in order to avoid injuries (37-39). The degree of spinal flexibility among athletes is enhanced by sports type (37-39) and by internal and external factors (40). Elite sporting activity is known to produce significant compressive forces often in positions involving end range of motion (41). Generally, level of flexibility in athletes relate to level of preparation and training in sports (37-39). The higher the qualification requirement for a sport type the greater the mobility of the athlete. However, the result of this study revealed no significant difference in extension ROM among practitioners of different sports. This finding was similar to the result of a study by Mbada et al (5) where no significant difference was found in the active lumbar extension ROM across different sport types in male collegiate sportsmen.

This present study presents a gender-reference mean scores and percentile data for spinal flexibility of non-athletes and athletes respectively. Percentile cut-points were used to define flexibility scores as poor (less than 25th percentile), medium (scores between 25th and 75th percentile), high (scores between 75th and (95th percentile) and very high (greater than 95th percentile). From the results, higher spinal flexibility values were found among the female participants except for the mean values for forward and left lateral flexion in non-athletes. Generally, greater trunk flexibility has been reported among female than male subjects (42-44). Anatomical, morphological and physiological variations have been implicated for the difference in flexibility between the sexes (2, 42-46).

The gender-reference cut-points of forward flexion, extension, right lateral flexion and left lateral flexion established in this study could be used to identify decreased spinal flexibility among athletes and non-athletes; and also facilitate in monitoring the effect of rehabilitation. Low spinal mobility condition is believed to limit normal joint kinematics and thereby predisposing an athlete to joint instability and/or injury. Therefore, empirical assessment of spinal ROM in athletes by physicians, physiotherapist and trainers may help in identifying the potential risk factors, aid injury prevention and inform appropriate training and rehabilitation (5). Bandy and Reese (47) submitted that increasing spinal flexibility may in turn improve the back muscles' and ligaments' responses to athletic demands.

The result of this study shows no significant correlation between age and each of forward flexion, extension, right lateral and left lateral flexion in both athlete and non-athlete groups. This finding of no significant relationship was consistent with a previous report by Mellin and Doussa (48) but at variance with other studies (21-23, 49). It is adduced that the no significant age influence on lumbar spine flexibility observed in this study may be as a result of the small age range of the participants. Furthermore, from this study, anthropometrical variables such as height and limb length were significant determinants of forward flexion among athletes only.

Conclusion

Lumbar spine flexibility was significantly greater in athletes than non-athletes. Both athlete and non-athlete females had higher lumbar spine flexibility than their male counterparts. Degree of forward and left lateral flexion seems to have sport-specific propensity. Limb length and body weight were determinants of lumbar spine flexibility.

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