Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2013, 4 (11):80-84
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Correlations of back strength with selected anthropometric variables and physical performance tests in elite Indian Cyclists

Shyamal Koley[1] and Vipul Kumar Jain[2]

[1]*Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India*
[2]*Department of Physiotherapy, Ayushman College, Bhopal, Madhya Pradesh, India*

ABSTRACT

The purpose of the present study was to estimate the back strength of elite Indian cyclists and its correlations with selected anthropometric traits and physical performance tests. To solve this problem, seven anthropometric traits viz. height, weight, BMI, total lower extremity length, buttack to knee length, lower leg length and foot length, three physical performance tests viz. sit and reach test, standing broad jump test and vertical jump test, and back strength were measured on randomly selected 57 elite Indian cyclists (31 males and 26 females) aged 18–24 years (mean 20.21 years, ± 2.11) from six Indian universities, competition was held in Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of controls (n = 63, 35 males and 28 females, mean 20.28 years, ± 2.14) were also taken from the same place for comparisons. The results indicated statistically significant differences (p<0.05 - 0.001) between Indian male and female cyclists with their control counterparts,(except weight in male cyclists and controls and height, BMI, lower leg length and foot length between female cyclists and controls) as well as between the two sexes of the cyclists. One way analysis of variance showed significant between-group differences (p ≤ 0.001) in all the variables studied between the cyclists and controls. In conclusion, it may be stated that back strength had some strong positive correlations (p< 0.01) with all the variables studied in elite Indian cyclists.

Keywords: Anthropometric characteristics, Back strength, Performance tests, Elite Indian cyclists

---

INTRODUCTION

Track cycling is a sprint as well as endurance game. Competitive cycling is among the most strenuous sports which require the highest personal endurance [7]. The performance of the cyclists can be enhanced by decreasing the various sources of resistance and increasing the power output of them [5, 6]. The speed of a cyclist is determined by the power generated from skeletal muscle contractions through physiological processes i.e. aerobic and anaerobic power and capacity. Optimal performance occurs when the power supply from all available energy sources is efficiently harnessed to maximize speed over the race distance [19].

In fact, muscular strength, endurance and flexibility are important components of healthy back functions. A number of studies reveal that muscle strength is critical to health and well-being [12,18,1,20]. Several external factors, viz. altitude [21], position of exerting strength [24], diet [9] and internal factors, viz. age, sex [17], height, weight [23] etc. influence the maximum force that can be exerted by a muscle [3].

It has been estimated that about 80% of low back pain arises in cyclists because of poor posture. Chronic low back pain in cyclists usually the result of the prolonged flexed position. Cause can be related to inter vertebral disc compression, traction on the facet joint capsules and traction resulting in muscle strain or ligaments sprain [22]. In cycling, a great amount of strength of the back muscles is required. Mechanical factors play an important role in the etiology of degenerative processes and injuries to the lumbar spine. The maximum capacity of the back muscles must be known if assessments are to be made of muscle endurance followed by muscle fatigue during playing conditions [16]. However, the anatomical and biomechanical structures of the back are extremely complex and consequently, accurately measuring back muscle strength is problematic outside of a research setting.

Though the importance of studying back strength is immense, literature related to back strength of the cyclists is scanty, especially in Indian context. So the present study was planned. The objectives of the present study were to estimate the back strength of Indian elite cyclists and to search any association of back strength with selected anthropometric variables and performance tests among them.

MATERIALS AND METHODS

Participants

The present cross-sectional study is based on randomly selected 57 elite Indian cyclists (31 males and 26 females) aged 18–24 years (mean 20.21 years, ± 2.11) from six Indian universities viz. Punjabi University, Patiala, Punjab University, Chandigarh, Guru Nanak Dev University, Amritsar, Kurukshetra University, Kurukshetra, Himachal Pradesh University, Himachal Pradesh and Delhi University, Delhi, and the competition was organized in Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of controls (n = 63, 35 males and 28 females, mean 20.28 years, ± 2.14)) with no particular athletic background were also collected from the same place for comparisons. The age of the subjects were recorded from the date of birth registered in their respective institutes. A written consent was obtained from the subjects. The data were collected under natural environmental conditions in morning (between 8 AM. to 12 noon). The study was approved by the institutional ethics committee.

Anthropometric measurements

Seven anthropometric variables, viz. height (HT), weight (WT) and BMI, total lower extremity length (TLEL), buttock to knee length (BKL), lower leg length (LLL) and foot length (FL), three physical performance tests, viz. sit and reach test (S&RT), standing broad jump test (SBJT) and vertical jump test (VJT), and back strength (BS) were taken on each subject. Anthropometric variables of the subjects were measured using the appropriate techniques [15] and were measured in triplicate with the median value used as the criterion.

The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula weight (kg)/height^2 (m)^2. Total lower extremity length was measured from the anterior iliospinale to the floor by anthropometer in cm. Buttock to knee length was measured from the rear most point of the buttock to the front of the knee cap by anthropometer in cm. Lower leg length was measured vertically between tibiale and Spherion by anthropometer in cm. Foot length was measured from pternion to acropodion by dyptiogarm in cm.

Back strength measurement

Back strength was measured using a back-leg-chest dynamometer. After 3 minutes of independent warm-up, the subject was positioned with body erect and knees bent so that grasped-hand rests at proper height. Then straightening the knees and lifting the chain of the dynamometer, pulling force was applied on the handle. The body would be inclined forward at an angle of 60 degrees for the measurement of back strength. The strength of the back muscles was recorded on the dial of the dynamometer as the best of three trials in kg. Thirty seconds time interval was maintained between each back strength testing.

Sit and reach test

The subject was asked to warm up properly and then made to sit on the floor with feet placed against the inner side of the box. With one hand over the other, the tips of the two middle fingers on top of one another, the subject was then asked to slowly stretch forward without bouncing or jerking and slide fingertips along the 20- inch scale as far as possible. The test was repeated thrice and best reading was recorded in inches.

Standing broad jump test

Standing broad jump test is a common and easy to administer test of explosive leg power. The athlete stood behind a line marked on the ground with feet slightly apart. A two foot take-off and landing was used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempted to jump as far as possible, landing on both feet without falling backwards. Best of longest straight distance score was measured by steel tape and was recorded in cm.

Vertical jump test

An adequate warm up with several easy jumps proceeded with a few minutes rest, which also served the purpose of reviewing the jumping technique of the subject. The subject was told to bend the knees immediately prior to the jump which activates the stretch-shortening cycle in the muscles, resulting in greater power production in the legs. The subject was asked to stand with side toward wall and reach up as high as possible keeping the feet flat on the ground to mark the standing reach height. As and when the subject was ready, with color on the distal part of his/her third finger (of right hand), he/she was asked to jump up as high as possible using both arms and legs to assist in projecting the body upwards and touch the wall at the highest point of the jump. The subject performed multiple attempts with short rests until a plateau or decrease in performance was observed and the best score was recorded in cm. The "net height" was calculated by subtracting the standing reach height from the jump height in cm.

Statistical analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. One way analysis of variance was tested for the comparisons of data among elite Indian Cyclist and controls, followed by post hoc Bonferroni test. Pearson's correlation coefficients were applied to establish the relationships among the variables measured. Linear regression was also done for further analysis. Data were analyzed using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Descriptive statistics of back strength, selected anthropometric variables and physical performance tests in elite Indian cyclists and controls were shown in Table 1. One way analysis of variance showed statistically significant ($p < 0.001$) between-group differences among the male and female cyclists and controls. Male cyclists have higher mean value (147.33kg) for back strength than female cyclists (88.50 kg) and their control counterparts (123.97kg). Female cyclists also have higher mean value for this trait than their control counterparts (69.50kg). When male cyclists were compared with their control counterparts, statistically significant differences ($p\leq 0.05$ - 0 .001) were found in all the variables except HT and BMI, whereas, female cyclists had significant differences ($p\leq 0.027$ – 0.002) also in all the variables except WT, BMI, LLL and FL with their control counterparts. However, significant sex differences ($p\leq .01$) were noted in all the variables studied, except BMI in the cyclists.

Table 1. Descriptive statistics of back strength, selected anthropometric variables and physical performance tests in elite Indian cyclists and controls

	CYM (n=31)		CM (35)		CYF (n=26)		CF (n=28)		F	Sing.
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.		
HT (cm)	171.94	5.11	172.59	4.37	162.06	4.65	158.63	9.40	57.193	0.001
WT (kg)	64.90	6.92	71.03	11.52	52.50	4.87	51.71	9.40	26.725	0.001
BMI (kg/m^2)	22.02	2.80	23.81	3.52	20.08	1.93	20.57	3.71	6.671	0.001
TLEL (cm)	102.87	3.14	98.22	4.30	95.58	2.76	91.15	4.44	37.296	0.001
BKL (cm)	56.71	2.20	51.60	3.56	55.02	1.29	44.54	6.91	34.437	0.001
LLL (cm)	40.26	1.40	38.76	1.27	37.31	1.38	37.04	2.30	16.975	0.001
F L (cm)	27.30	2.03	27.35	1.28	24.29	1.08	24.58	1.27	29.855	0.001
S & RT (cm)	18.59	4.66	10.91	5.86	15.67	3.64	8.07	7.90	13.378	0.001
SBJT (cm)	196.67	36.78	170.63	33.99	157.50	19.96	125.85	20.68	24.103	0.001
VJT (cm)	46.27	5.50	39.67	7.14	31.27	4.44	23.07	5.46	69.143	0.001
BS (kg)	147.33	31.99	123.97	18.17	88.50	16.48	69.50	13.44	67.771	0.001

CYM = cyclist males, CYF = cyclist females, Cm = control males, CF = control females, HT = height, WT = body weight, BMI = body mass index, TLEL = total lower extremity length, BKL = buttock to knee length, LLL = lower leg length, FL = foot length, S&RT = sit and reach test, SBJT = standing broad jump test, VJT = vertical jump test and BS = back strength

Table 2 showed the bivariate correlations of back strength with selected anthropometric variables and physical performance tests in Indian elite cyclists. Back strength had significantly positive correlations ($p \leq .01$) with all the variables studied (except S&RT). Among the anthropometric variables, significantly positive correlations were noted in almost all the variables.

Table 2. Correlation matrix of back strength, selected anthropometric variables and physical performance tests in elite Indian cyclists and controls

Variables	HT	WT	BMI	TLEL	BKL	LLL	FL	S&RT	SBJT	VJT	BS
HT	1	.496**	-.068	.582**	.395**	.584**	.685**	.204	.371*	.604**	.736**
WT	.692**	1	.829**	.846**	.611**	.779**	.577**	.242	.520**	.526**	,581**
BMI	.912**	.343**	1	.115	.045	.170	.408*	.068	.068	.341*	.463**
TLEL	.467**	.848**	.144	1	.691**	.835**	.704**	.310	.607**	.708**	.733**
BKL	.512**	.517**	.403**	.372**	1	.570**	.600**	.211	.464**	.398*	.430*
LLL	.298*	.522**	.096	.509**	..307*	1	.680**	.423*	.555**	.659**	.688*
FL	.462**	.676**	.242	.580**	.472**	.520**	1	.282	.405*	.569**	.698**
S&RT	.187	.005	.263*	-.110	.251*	-.084	.190	1	-.052	.297	.331
SBJT	.380**	.544**	.195	.465**	.314*	.104	.451**	.167	1	.547**	.433*
VJT	.487**	.662**	.268*	.505**	.484**	.285*	.601**	.267*	.662**	1	.752**
BS	.647**	.727**	.440**	.553**	.565**	.448**	.766**	.297*	.567**	.783**	1

*Upper triangle correlations for Elite Indian cyclists and lower triangle correlations for controls; * Significant at 0.05 level (2-tailed); ** Significant at .01 level (2-tailed).*

DISCUSSION

Athletes with poor back muscle endurance are prone to injury [14]. It was also reported that reduced back extensor muscle endurance might be a major risk factor for non-specific low back pain [4,2]. Thus, assessment of back endurance is one of the important preventive measures for sports persons. Cycling is an endurance game requires comprehensive ability including physiological, physical, mental, anthropometric and technical abilities. It was reported that a battery of anthropometric and morphological tests can distinguish between players of different ability in the same sport [8]. Elite track cyclists possess key physical and physiological attributes which are matched to the predisposition which is then maximized through effective training interventions [6]. Low back pain is one of the common problems in cyclists, because of sitting posture during cycling. One important component of injury prevention is the identification of potential risk factors. Risk factors for low back and lower extremity injury include muscular imbalances and dysfunction. It is essential to estimate the strength of back muscles of the cyclists to keep the injuries at bay, also for their enhancement of performance.

In the present study, statistically significant differences ($p < 0.001$) were found between male and female cyclists with their control counterparts. These differences were probably due to the effects of regular physical exercise and strenuous training program in the cyclists. Significant sex differences were also noted in the cyclists showing male cyclists predominantly stronger for their back strength. Anatomical, physical and physiological factors might be the reasons for these differences, also more musculature in male cyclists due to presence of testosterone hormone in them. More musculature generates more force in their back region. Differences in mode of training programs in cyclists of these two sexes might be another reason.

It was also found that back strength had significantly positive correlations ($p \leq .01$) with all the variables studied (except S&RT). Statistically significant correlations were found among the anthropometric variables themselves (which was obvious). It was reported earlier too, that several anthropometric variables were strongly correlated with back strength in different populations [20,10,11]. Lanning et al. [13] also found a close association between back endurance and hip strength in collegiate athletes. The novel part of the study was that, back endurance had strong correlations with the two performance tests studied. The limitations of the study were the small sample size with only inter-university data. In the future study both these limitations will be taken care.

CONCLUSION

It may be concluded from the present study that, significant between-group differences ($p \leq 0.001$) were found in all the variables studied between the cyclists and controls. It was also observed that back strength had some strong positive correlations ($p < 0.01$) with all the variables studied (except sit and reach test). The data presented in the study carry immense practical applications and should be useful in future investigation on player selection, talent identification in cycling avoidance of back pain and training program development.

REFERENCES

[1] Astrand, PO. and Rodahl, K. *Text Book of Work Physiology: Physiological Cases of Exercise.* 2nd Ed. McGraw-Hill Inc., New York. **1986**.
[2] Beckman, S.M. and Buchanan, T.S. *Archives of Physical Medicine and Rehabilitation*, **1995**, 76(12): 1138–1143.
[3] Berne, RM. and Levy, MN. Physiology. St. Louis, MO.: CV Mosby Co. **1983**.
[4] Biering-Sorensen, F.A. *Spine*, 1984, 9: 106-119.
[5] Cgaig, N.P. and Norton, K.I. *Sports Med.*, **2004**, 31(7): 457-468.
[6] Craig, NP. and Norton, KI. *Sports Med*. **2001**. 31 (7): 457-468.
[7]Dopsaj, M., Nikolic, B., Mazic, S. and Zlatkovic, *J. Acta Medica Medianae*, **2010**. 49(3):UDC: 796.61:613.73:612.173.
[8] Keogh, J. *Journal of Sport Science and Medicine*, **1999,** 2: 125–133.
[9] Keys, A., Brozek, J., Henschel, A., Mickelsen, O. and Taylor, HN. *Biology of Human Starvation*. University of Minnesota Press, Minneapolis. **1950**.
[10] Koley S., Jha, S. and Sandhu, JS. *The Anthropologist*, **2012b**, 14(4): 359-363.
[11] Koley, S., Kalsi, R and Sandhu, JS. *The Anthropologist*, **2012a**, 14(4): 339-346.
[12] Kraus, H. and Hirschland, RP. *Research Quarterly*, **1953**, 25: 177-188.
[13] Lanning, C.L., Uhl, T.L., Ingram, C.L., Mattaocola, C.G., English, T, Newsom, S. *Journal of Athletic Training*, **2006**, 41(4): 427–434.
[14] Latiner, J., Maher, C.G., Refshauge, K., Colaco, I. *Spine*, **1999**, 24: 2085-2090..
[15] Lohmann, TG., Roche, AF. and Martorell, R. Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics Books, **1988**.
[16] Mannion, AF., Adams, MA., Cooper, RG. and Dolan, P. *Rheumatology*,**1999**, 38: 652-655.
[17] Mathiowetz, V., Rennells, C. and Donahoe, L. *Archives for Physical Medicine and Rehabilitation*, **1985**, 66: 69-74.
[18] McDonangh, MJN. and Davies, CTM. *European Journal of Applied Physiology*, **1984**, 52: 139-155.
[19] Olds, TS., Norton, KI., Craig, NP. *J Appl Physiol*. **1993**. 75: 730-737.
[20] Roy, SK. and Pal, B. *International Journal of Anthropology*, **2001**, 16(4): 263-273.
[21] Ruff, S. and Strughhold, H. *Compendium of Aviation Medicine*. WADA Technical Report 14. OH.Wright Air Development Centre, Air Research and Development Command. United States Air Force, **1942**, pp. 32-34.
[22] Salai, M., Brosh, T., Blankstein, A., Oran, A., Chechik, A. *British Journal of Sports Medicine*, **1999**, 33:398-400.
[23] Schimdt, RT. and Toews, JV. *Arch Phy Med Rehabi*, **1970,** 51: 321-327.
[24] Teraoka T. *Kobe J Med Sci*, **1979**, 25:1-17.