

Obesity - Motor Ability Linkage: A Study on Adult Bengalee Kathak Danseuses

Abstract : The challenges posed by obesity are both a reality and a threat to the nation's health and economic well-being. The increase in the morbidity, mortality and health-care cost of obesity emphasizes the importance of public health interventions. On the other hand, apart from appropriate nutritional intake, adequate physical activity also contributes to the development of physical well being. Moreover, physical activity has a positive impact on the motor ability of the individuals regularly practising it. In this back drop, the present study aims to find out the relationship, if any, between motor ability and obesity status, assessed in terms of anthropometric indicators, of Kathak dancing and non – dancing adult females of Kolkata. Motor performance analyses along with related anthropometric measurements were carried out for the individuals of both the two groups. Some obesity indices were calculated and were found to have significant negative relationship ($P < 0.05$) with the motor ability variables. It may be concluded that the Bengalee Kathak danseuses not only have favorable body composition, as assessed in terms of several indices, but also simultaneously have a better physical fitness status adjudged in terms of motor ability indicators, compared to their non-exercising counterparts; thus Kathak Dancing (KD) can serve as a potential tool for the desired healthy living agenda.

Keywords: physical fitness, motor skill, anthropometry, central obesity, classical dancing, flexibility

Obesity: A Public Health Challenge: Obesity, accumulation of excess adipose tissue, increases the likelihood of various chronic diseases and poses an enormous stress on the socio economic and public health system, even in less developed countries like India (WHO)¹. Obesogenic environments have increased, owing to the consumption of calorie-dense foods of low nutritional value and the reduction of daily physical activity. Currently, obesity affects more than 30 percent of adults² and approximately 16 percent of children and adolescents aged between two to nineteen years in US³. The health consequences of obesity ranges from respiratory difficulties and musculoskeletal disorders to increased risk of premature death due to type 2 diabetes, and cardiovascular problems⁴. It has been reported that 61 percent of obese young people had at least one additional risk factor and 39 percent had at least two additional risk factors for heart disease⁵. Childhood obesity is a risk factor for severe obesity over

the life span, and youth with a BMI greater than the 95th percentile have an increased likelihood of developing obesity-related chronic diseases earlier in life that they will have to manage throughout their lifetime⁶. Another important aspect of obesity is the healthcare cost of its comorbidities over the entire lifespan. Direct and indirect medical expenses owing to both overweight and obesity have significantly increased⁷; more than 25 percent rise in medical costs in terms of medicare or medicaid has been attributed to obesity in US⁸. The burden is posing to be a serious threat on the limited health care resources for low and middle income countries like India⁹. Hence it is very important to develop some new method—may be in terms of a therapy with a low cost intervention—to fight the challenge¹⁰.

Motor Ability–The Concept: Based on the International Classification of Functioning, Disability and Health (ICF) model, participation in everyday activities is integral to normal child's development and influences positively on health, quality of life¹¹, and future life outcomes^{12, 13}. Physical activity, even of moderate extent, has a positive impact on the motor ability - the ability related to the performance of motor skill - playing a crucial role in the social and emotional functioning of an individual. Each motor skill requires specific motor abilities to establish the potential of the specific performance. Motor ability can be assessed in terms of flexibility, strength and balance, each of which plays a significant role in the long term healthy living. Decline in posture and balance due to muscle weakness and other risk factors has the negative consequence - 'Falls', in the aging society¹⁴. It is also due to poor motor ability in terms of flexibility and strength. Adequate flexibility is an important characteristic of physical and health related fitness¹⁵. Another importance of flexibility is prevention of orthopedic impairments in later life, especially lower back pain¹⁶. Flexible muscles permit proper pelvic rotation, decreased disc compression, and avoid excessive stretch of musculatures^{17,18}. It is thus also important for the adult population to ensure better motor ability in terms of balance, flexibility and strength.

Dance and Motor Ability – Tracing the Linkage: Dance, a primordial source of motion art¹⁹, is a form of physical activity with complex spatio - temporal skill and coordination abilities²⁰, that is physically and mentally

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demanding²¹. It is a specified kinematic motion task performed, without neglecting the external aesthetics²². Kathak, the north Indian classical dance, involves rhythmic footwork, linear and circular extension of the body with controlled coordination between hand and body. A Kathak dancer is required to synchronise the lower extremities of the body with a refined bearing of the trunk and upper extremities to make a harmonious and concerted performance; another hallmark of the dance is rigorous and repetitive practice which is also a unifying theory and a strategic plan in the acquisition and consolidation of motor learning²³.

In this backdrop, the present study aims to find out the impact of Kathak dancing (KD) on body composition, adjudged in terms of several indices, and fitness status, assessed in terms of motor ability indicators ; and also to find out the relationship, if any, between motor ability and obesity indices of Kathak danseuses of Kolkata.

Methodology : The study was carried out on 21 adult Bengalee female individuals undergoing KD training, age range 18–25 years, after obtaining necessary human ethical clearance, along with the individual and institutional consents from the centres imparting KD training. After obtaining the initial consents from the individuals, the names of volunteers were enlisted and the procedural requirements were explained elaborately. Adult females satisfying the inclusion criteria of receiving training for a minimum period of 5 years and practicing it regularly for about an hour for 6 days a week were considered for inclusion in Kathak Dancing Group (KDG). Females of comparable age and socio-economic background, but not receiving training in any form of dance and also not formally exercising, constituted the Control Group (CG) (n = 28). Individuals on medication (self - reported) for hypertension, T2DM and like were excluded. Information about age (year), daily activities hours and food habits were recorded in a pre-designed schedule. Socio-economic status (SES) was assessed using updated Kuppuswamy scale²⁴. Anthropometric measurements - stature(cm), straight leg length (cm), knee height (cm) and arm span (cm) - were obtained using anthropometric measurement set with an accuracy of 0.1cm²⁵. Body weight (kg) using electronic weighing scale with an accuracy of 0.1kg with individuals in light clothing and without shoes, was noted. Waist Circumference (WC) at the midpoint between the last rib and the iliac crest, with the subject standing, after complete exhalation²⁶ and Hip Circumference (HC) at the maximum circumference over the buttocks with the arms relaxed at the sides²⁷ were measured with an accuracy of 0.1 cm, using a narrow (19 mm), flexible, inelastic standard

measuring tape. To reduce the inter-observer measurement variation coefficients, all anthropometric measurements were obtained by the same investigator²⁸. Obesity indices in terms of Body Mass Index (BMI), Body Mass Abdominal Index (BMAI), Waist Hip Ratio (WHR), Waist to Body Height Ratio (WHtR), Conicity Index (CI), and Abdominal Volume Index (AVI) were calculated. Motor performance analyses were done by Sit and Reach Test for lower back and hamstring flexibility²⁹, 30 second Sit up Test for abdominal strength³⁰, handgrip strength measurement using handgrip dynamometer²⁹ and balance test³¹. All measurements were taken in the morning hours with ambient temperature around 25^o- 27^oC. The data of KDG and CG were compared to find out any significant difference. Correlation was carried out between the obesity indices and the motor ability variables of the KDG individuals to find out their association. P value lower than 0.05 (P < 0.05) was considered significant.

Results and Discussions : Present study was conducted on 21 and 28 Bengalee female adults residing in and around Kolkata, constituting KDG and CG respectively. All individuals of KDG and CG were of comparable age and socio – economic status (Table 1).

TABLE1: Background Information of Study Participants

Variables	KDG	CG
Sample size (n)	21	28
Age (years)^	20.1 ± 2.5	20.1 ± 1.71
Socio – economic status^	Middle	Middle
Type of exercise	KD	Nil

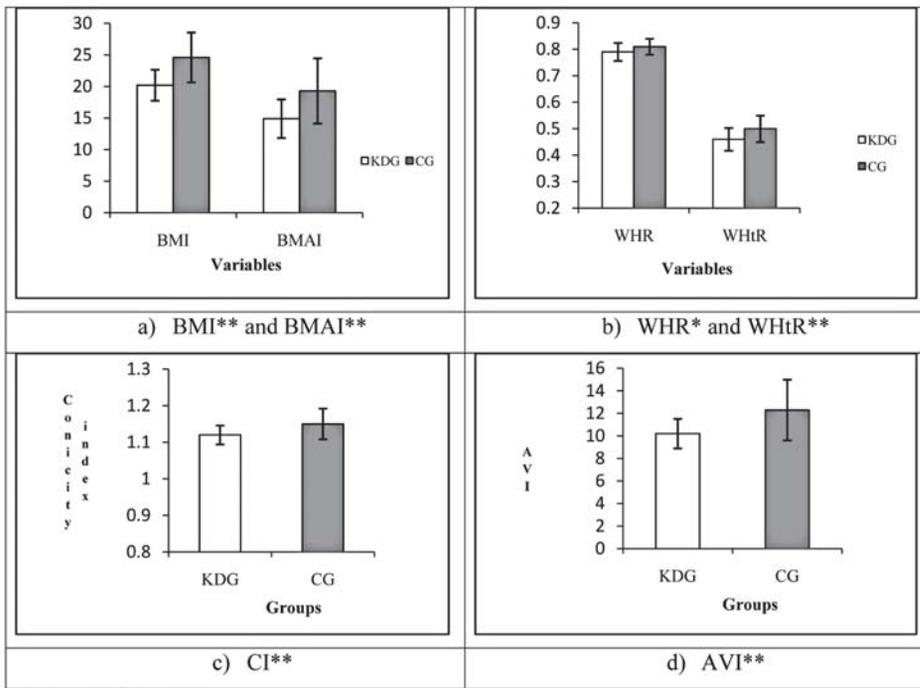
AM ± SD; ^ ns

Anthropometric characteristics of the KDG and CG individuals are presented in Table 2. The individuals of the two groups had no significant difference in terms of stature (cm) and knee height (cm), but had significant difference (P < 0.01) in terms of straight leg length (cm), arm span (cm) and body weight (kg).

TABLE 2: Anthropometric Characteristics of KDG and CG Individuals

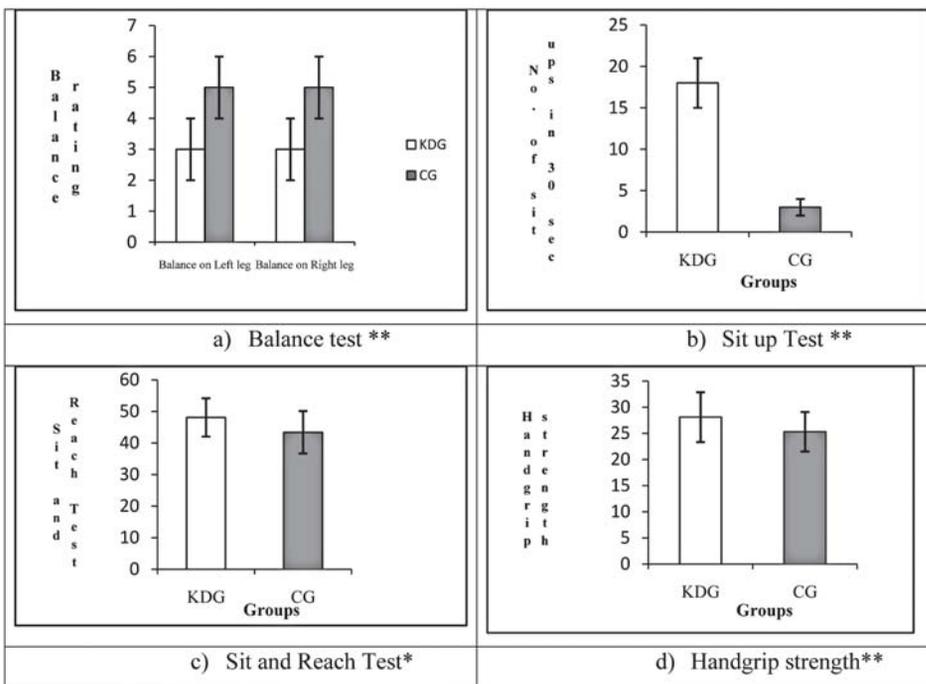
Variables	KDG	CG
Stature (cm)^	154.4 ± 7.82	154.2 ± 7.13
Straight leg length (cm)**	71.3 ± 6.24	69.1 ± 3.38
Knee height (cm)^	41.8 ± 1.57	41.8 ± 2.24
Arm span (cm)**	157.2 ± 5.14	155.7 ± 6.4
Body weight (kg)**	47.9 ± 7.42	58.9 ± 12.9

AM ± SD; ^ns, ** P < 0.01



ns, *P < 0.05, ** P < 0.01

Fig 1: Comparison between KDG and CG individuals in respect of BMI and BMAI (a) WHR and WHtR (b) CI (c) and AVI (d)



*P < 0.05, ** P < 0.01

Fig 2: Comparison between KDG and CG individuals in respect of Balance test (a) Sit up Test (b) Sit and Reach Test (c) and Handgrip strength (d).

In figure 1, the obesity status has been compared and depicted with a column diagram with indices - BMI and BMAI (a), WHR and WHtR (b), CI (c) and AVI (d).

In figure 2, the motor performance indicators in terms of balance ratings (a), 30 second Sit up Test (b), Sit and Reach Test (c) and Handgrip strength (d) are presented.

On finding significant (P<0.01) difference between the KDG and CG individuals in terms of obesity indices as well as motor ability variables, the coefficient of correlation was found out between the obesity indices and motor ability variables of the KDG individuals. The correlation matrix for the KDG individuals is presented in table 3.

Our earlier studies have observed that KD had a positive impact on the body composition parameters³² and Bharatnatyam dancing (BD), a South Indian classical dance, had positive impact on the motor ability variables in addition to its positive influence on body composition indicator of adult Bengalee female individuals²⁰. The present study was aimed to assess the impact of KD on motor ability along with body composition parameters. The study was carried out on 21 KDG and 28 CG individuals of comparable age and socio-economic status (table 1). The individuals of the two groups were also comparable in terms of their stature and knee height, but differed significantly (P < 0.01) in terms of body weight, straight leg length and arm span (table 2).

Adults are referred to as overweight when, as per WHO recommendation, the value of BMI, the common indicator of obesity, exceeds 23; the individuals get into the risk zone for obesity related co-morbidities^{33, 34}. The mean BMI of KDG individuals is significantly lower (P < 0.05),

TABLE 3 : The correlation matrix on the relationship - among the anthropometric indices of obesity and motor ability indicators - KDG individuals

	BMI	BMAI	WHR	WHtR	CI	AVI	Balance rating	Number of Sit ups	Sit and Reach Length	Handgrip Strength
BMI	1	0.94**	0.56**	0.78**	0.26	0.87**	- 0.14	0.56**	0.16	0.20
BMAI		1	0.61**	0.88**	0.46*	0.95**	- 0.13	0.67**	0.17	- 0.31
WHR			1	0.87*	0.40*	0.61**	-0.55**	0.07	- 0.04	0.11
WHtR				1	0.52*	0.85**	- 0.21	0.61**	0.11	0.35
CI					1	0.44**	- 0.31	-0.42*	- 0.47*	0.05
AVI						1	- 0.35	0.72**	0.15	- 0.08
Balance rating							1	-0.03	0.11	0.07
No. of Sit ups								1	0.49	0.97*
Sit and Reach length									1	0.04
Handgrip strength										1

* P < 0.05, ** P < 0.01

compared to their CG counterparts; the mean BMI of CG individuals have crossed the lower limit of being referred to as overweight for Asians, as per WHO recommendation³⁵; similar trend of result was observed in earlier studies carried out with adolescent Bharatnatyam danseuses^{9, 35} and male football players³⁶. Recent studies show the trend of abdominal obesity to be increasing, in both developed and developing countries³⁷. The mean BMAI, an indicator of abdominal obesity, of the KDG individuals is significantly lower (P < 0.01) than their CG counterparts ; implying reduced likelihood of having health related co –morbidity in the KDG individuals (fig 1 a) in agreement with other studies carried out on adolescent Bharatnatyam danseuses^{9,38,39} and rural sedentary female workers⁴⁰. WHR is an important indicator of central obesity and cardiovascular risk^{41, 42}. The Asian population exhibits increased WHR and is likely to reflect in increased visceral adipose tissue mass^{43,44}. In the present study, the KDG individuals have lower value of WHR whereas the CG individuals have exceeded the cut – off limit (0.80) of WHR marginally. A still better predictor of abdominal obesity is WHtR, and is more closely related to CVD morbidity and mortality. The mean WHtR of the KDG individuals is significantly lower (P < 0.01) than the CG individuals indicating favourable WC and may prevent the KDG individuals from the future complications⁴⁵(fig 1b). CI, another measure of central adiposity is found to be related with atherogenic risk factors, and is considered to be a better indicator, compared with WHR for identifying high trunk fat. In the present study, the KDG individuals have significantly lower (P < 0.01) CI value compared to their sedentary CG counterparts (fig 1c); this is in

agreement with earlier study done on sedentary office workers⁴⁶. AVI, yet another central adiposity marker was also significantly lower (P < 0.05) in KDG individuals (fig 1d).

On observing significant difference in the obesity indices among the KDG and CG individuals, motor performance analyses were carried out to compare the motor ability of the two groups in terms of balance, flexibility and strength (fig 2). Balance is the ability to maintain the body’s center of mass (COM) within the limits of the base of support⁴⁷. Hence a better ability maintains the COM within the base of support and prevents external forces to disturb balance and thus help maintain upright posture⁴⁸. In the present study, it is observed that the KDG individuals have significantly higher (P < 0.01) balance (specified by the lower ratings) in both right and left leg, compared to their CG counterparts indicating the better ability of the KDG individuals in vertically locating the center of gravity (fig 2 a); this is in tune with earlier studies carried out on Bharatnatyam danseuses²⁰. The abdominal strength was estimated by Sit up Test; the results indicated that the KDG individuals had significantly (P<0.01) better abdominal strength compared to CG individuals (fig 2 b). This may be due to the quick, successive and harmonious movements required in KD which exerts predominant action on the trunk and lower extremities. The physical fitness components were tested by flexibility test, one of the most homogeneous test¹⁶in terms of classification. Flexibility is described as the ability to move a joint through its complete range of motion. It is the extensibility of muscles as well as the non-contractile tissues such as joint capsule,

ligaments, and tendons¹⁷. Better flexibility is important to prevent orthopedic impairments and allow proper pelvic rotation, decreased disc compression, and avoid excessive stretch of musculatures¹⁸. The lower back and hamstring flexibility was assessed by Sit and Reach Test; it was observed that the KDG individuals have more flexibility compared to their CG counterparts (fig 2 c). Another component of motor ability is motor coordination; it is primarily regulated by two mechanisms, - force-regulation (explosive strength) and speed regulation (movement frequency), - that determine performance of the dance structures¹⁹. The force regulation in the present study is assessed in terms of handgrip strength in both KDG and CG individuals. It is observed that the KDG individuals have significantly higher ($P < 0.01$) strength than CG individuals (fig 2 d), indicating the gain of better motor ability in KDG individuals.

It has been reported that KD has beneficial impact on the obesity indices⁴⁹. The results of the present study also indicated that it has positive influence on the motor performance variables; findings are in consonance with one of our earlier studies²⁰. Further a correlation assessment was carried out between the obesity indices and motor ability variables of the KDG individuals. It was observed that there exists a significant ($P < 0.05$) negative correlation between the CI and motor ability assessed in terms of the sit up test and the sit and reach test; undergoing training in cricket has also been found to be beneficial in improving motor performance as has been reported in one of our recent studies⁵⁰. There also exists a significant ($P < 0.01$) negative correlation between WHR and Balance test (table 3). Finally it may be mentioned that regular practising a form of Indian classical dancing like BD or KD is beneficial from the standpoint of body composition, fitness, cognitive performance betterment and psychological wellbeing as also reported in our series of earlier studies^{39,51,52} and corroborated in the present study on individuals undergoing KD training.

Conclusion: It may be concluded in the light of the present study that the Bengalee Kathak danseuses do not only have favorable body composition as assessed in terms of several indices, they also do simultaneously have a better physical fitness status adjudged in terms of motor ability indicators, compared to their non-exercising counterparts; thus Kathak dancing can serve as a potential tool for the desired healthy living agenda. □

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Received : 14 June 2017

Revised : 18 October 2017

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