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RESPIRATORY FUNCTIONS IN *KALARIPAYATTU* PRACTITIONERS

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Abstract : *Kalaripayattu,* an ancient traditional martial art form of Kerala, is considered as the basis for all martial arts viz. Karate, Kungfu, etc. physiological studies are more concentrated on Karate, Kungfu and other martial arts due to their global acceptance. Considering the limited knowledge available regarding the physiological profiles of *Kalaripayattu* practitioners, the present study was taken up for filling the lacunae in the field. Lung function tests were carried out in ten Kalari practitioners. Residual volume was measured by indirect method. Higher lung volumes and flow rates were achieved in Kalari practitioners compared to age and height-matched controls. Better mechanical factors and lower airway resistance influenced during Kalari practice might have benefited in improving hung volumes and flow rates.

Key words : lung volumes flow rates *Kalaripayattu*

INTRODUCTION

Kalaripayattu means battlefield practices or training that takes place in an arena or a gymnasium of specific dimensions with mud flooring. This is an ancient traditional martial art form of Kerala, India. Basis of all martial art form like Karate, Kungfu was originally developed from *Kalaripayattu*. The northern styles of *Kalaripayattu* are characterised by high jumping and kicking techniques, low stances, blows and blocks delivered by arms and leg that are almost fully extended and a high level of energetic and acrobatic movement. Warming up gymnastic techniques are very strenuous. Pattern of movements called Suvadus and several breathing techniques, probably taken from yoga are found in its training regimen. The exercise taught in the Kalari right from the basic of the practitioner are all designated to given strength to the lowest point in the vertebral column (Kundalani). *Kalaripayattu* exercises involve the usage of different body parts like hands, feet, elbow, knee and head. All these exercises or steps in *Kalaripayattu* were synchronised

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with breathing rhythm. Considering the involvement of breathing in *Kalaripayattu* prompt us to take up the study on lung functions in *Kalaripayattu* practitioners. Comparative study between performers with age and height matched controls were carried out to study the alterations of lung functions achieved by *Kalaripayattu* practice.

METHODS

Male Kalari practitioners were selected from CVN Kalari (Kerala Sports Council recognised) at Kaduthuruthy, Kerala, India, under the guidance of world renowned Kalari Master Sri Vasudevan Gurukkal. Ten professional Kalari practitioners with more than five years of experience in the field were included for the study. *Kalaripayattu* practitioners performed their regular training of warm up exercise followed by 'Chuvadukal' or pattern of steps and 'Vadivukal' or different postures for an all out performance.

Physical characteristics viz. age and height were measured. Residual volume is derived from VC by the calculation proposed by Sunil Das and Chatterjee (1). Respiratory function tests were carried out during morning hours using Vitallograph Compact II (Buckingham, U.K.). A comparative study on *Kalaripayattu* performers with age and height matched normal controls were also carried out.

RESULTS

Mean values of physical characteristics of *Kalaripayattu* warriors were age (21.3 ± 2.23 years) height (172.15 ± 9.57cm), and age and height of controls were 21.44 years and 169.80 cm respectively. Lung volumes viz. VC ($P<0.001$), FVC, FEV_1, MVV ($P<0.05$), $FEV_1/VC\%$ ($P<0.05$) and ($P<0.01$) PIF ($P<0.005$), FIF75% ($P<0.001$), FIF50% ($P<0.005$) and FIF25% ($P<0.005$) also recorded a higher value in *Kalaripayattu* practitioners than normal controls (Table II).

TABLE I: Lung volumes in *Kalaripayattu* practitioners.

Parameters	*C (n = 25) Mean ± SD*	*AR (n = 10) Mean ± SD*	*P value C v/s AR*
VC (L)	3.21±0.47	3.99±0.64	P<0.001
IVC (L)	2.28±0.45	2.31±0.31	NS
FVC (L)	3.28±0.47	3.76±0.74	P<0.05
$FEV_{0.5}$ (L)	2.21±0.33	2.45±0.28	NS
$FEV_{0.5}$/FVC (%)	67.80±10.19	65.14±7.81	NS
FEV_1 (L)	2.92±0.40	3.30±0.47	P<0.05
FEV_1/VC (%)	90.17±8.10	83±3.31	P<0.05
FEV_1/IVC (%)	129.83±21.23	144.13±16.78	NS
FEV_1/FVC (%)	88.80±7.88	86.86±4.93	NS
MVV_{ind} (L)	108.72±15.21	123.76±17.51	P<0.05
RV_{ind} (L)	1.07±0.10	1.20±0.16	P<0.01

C – Controls; age (21.44 ± 1.58), height (169.80 ± 6.11)
AR – *Kalaripayattu* subjects at rest; age (21.3 ± 2.23), height (172.15 ± 9.57)

Plate 1

Sarpavadivu

Plate 2

Kukadavadivu

Plate 3

Matsyavadivu

Plate 4

Varahavadivu

Plate 5

Gajavadivu

Plate 6

Simhavadivu

Plate 7

Aswavadivu

Plate 8

Mayooravadivu

TABLE II: Flow rates in *Kalaripayattu* practitioners.

Parameters	*C (n = 25)* *Mean ± SD*	*AR (n = 10)* *Mean ± SD*	*P value* *C v/s AR*
PEF (1/min)	3.63±76.30	423.59±40.01	P<0.05
$FEF_{0.2-1.2}$ (1/sec)	5.48±1.40	6.55±0.77	P<0.05
FEF_{25}75% (1/sec)	3.65±0.94	3.77±0.51	NS
FMFT (sec)	0.46±0.13	0.52±0.10	NS
$FEF_{75-85\%}$ (1/sec)	1.61±0.56	1.50±0.27	NS
$FEF_{25\%}$ (1/sec)	5.53±1.31	6.22±0.85	NS
$FEF_{50\%}$ (1/sec)	3.98±0.97	4.14±0.45	NS
$FEF_{75\%}$ (1/sec)	1.99±0.60	1.96±0.36	NS
PIF (1/sec)	3.95±1.13	5.46±1.21	P<0.005
$FIF_{75\%}$ (1/sec)	3.19±0.97	5.76±1.28	P<0.001
$FIF_{50\%}$ (1/sec)	3.63±1.23	5.19±1.34	P<0.005
$FIF_{25\%}$ (1/sec)	3.25±1.13	4.70±1.16	P<0.005

C – Controls; age (21.44 ± 1.58), height (169.80 ± 6.11)
AR – *Kalaripayattu* subjects at rest; age (21.3 ± 2.23), height (172.15 ± 9.57)

DISCUSSION

Kalaripayattu involves several body postures and stances which are attained by different stances or steps. Body postures involve Sarpavadivu (Snake posture), *Kukadavadivu* (Cock posture), *Matsyavadivu* (Fish posture), *Varahavadivu* (Bore posture), *Gajavadivu* (Elephant posture), *Simhavadivu* (Lion posture), *Ashwavadivu* (Horse posture) and *Mayooravadivu* (Peacock posture). These postures and stances include total body movements. These body movements include involvement of activity of respiratory muscles and chest muscles.

Lung volumes VC, FVC, MVV, RV and timed volume (FEV_1) were significantly higher in Kalari performers than controls. This clearly shows the ability of mechanical factors like elastic recoil of lungs and conductive properties of larger airways in *Kalaripayattu* performers than normal controls. Repeated heavy exercise to ventilatory muscles is synchronised with exercises, viz., high jumping and kicking techniques, long strides, long stances and blow and blocks by arms and hands stretched. Repeated heavy exercise results in respiratory muscle hypertrophy which would account for larger static lung volumes which depend partly on the muscle power (2, 3, 4). Continuous upper body exercise and arm stretch exercise result in improved chest surface area with chest mobility which might lead to higher lung volumes (5, 6). Most of the *Kalaripayattu* exercise involves the technique of breath holding associated with yoga. The yoga exercise is considered to be beneficial for improved lung functions (7). Yoga training will benefit to hold breath near total lung capacity (7, 8). This breath holding capacity will benefit in improved lung volumes (9). Ventilatory stress specifically due to breath holding which

imposes respiratory muscle strength (10, 11).

The flow rates of *Kalaripayattu* warriors showed a significantly higher result as compared to normal controls. This shows the efficiency of lower airways with less airway resistance in *Kalaripayattu* warriors than the age and height matched controls. The factors affecting flow rates also include elastic recoil of lungs and the characteristics of the intrathoracic airways (12). Another reason for the increased flow rates is the higher lung volumes of *Kalaripayattu* warriors (13). The study on 'lung volumes' and 'flow rates' in *Kalaripayattu* warriors with age and height-matched controls reveals that *Kalaripayattu* warriors attained a higher lung function through training in Kalari exercise.

To sum up, *Kalaripayattu* performers show higher lung function status achieved by exercise training. Different postures and stances in *Kalaripayattu* together with involvement of breathing exercises like yoga in the exercise protocol may have influenced in the higher lung volumes and flow rates.

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