Scientia Africana, Vol. 16 (No. 2), December 2017. Pp 282-290
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

COMPARISON OF PULMONARY PERFORMANCE OF ATHLETES ADMINSTERED ASCORBIC ACID AND SALBUTAMOL

F. F. Egbono

Department of Human Physiology, Faculty of Basic Medical Sciences, College of Health Sciences
University of Port-Harcourt, Nigeria
Email Address: ike.choko01@gmail.com, chidozieennoch@gmail.com, 08059211504

Received: 08-08-17
Accepted:18-08-17

ABSTRACT

The relationship between Ascorbic Acid (vitamin C) and pulmonary function has been reported to be a protection against pulmonary dysfunction. Sympathomimetics like salbutamol are respiratory smooth muscle relaxants. This research work is aimed at investigating the roles of ascorbic acid (vitamin C) and salbutamol on the pulmonary function athletes. Subjects who gave their consent were interviewed through questionnaire for medical history and those with respiratory or cardiovascular disorders were excluded. A total of 100 subjects were used, 50 for each test group (Ascorbic Acid and Salbutamol). Spirometry and peak flow (PEFR) measurements were done on each subject; Ascorbic Acid was given orally at a dose of 1.50mg/kg body weight and Salbutamol at a dose of 70µg/kg body weight orally. The body mass index (BMI), age, and sex were considered. Measurements were taken before and after one hour of administration of drugs. The results show mean PEFR male and female for Ascorbic Acid test group as 535.2±207.79L/Min and 322.76±20.39L/Min respectively. Salbutamol group PEFR male and female as 364.8±23.20L/Min and 325.6±20.45L/Min respectively. Non athletes (Control groups) PEFR male and female as 450.6±51.45L/Min and 290±34.90L/Min for ascorbic acid, 318±16.26L/Min and 275.20±14.77L/Min for Salbutamol respectively. Ascorbic Acid increases PEFR much more than Salbutamol. ERV, IC, VC and IVC were increased by Ascorbic Acid compared to Salbutamol. The research work shows that the performance enhancing role of Ascorbic Acid was more pronounced in males than females compared with Salbutamol in athletes.

INTRODUCTION

It is generally conceded that for normal, healthy individuals, there is no limit to exercise performance imposed by the respiratory system (Astrand and Rodahl, 1970). However, should athletes suffer from respiratory function impairment, then there appeared to be a definite relationship between exercise performance and respiratory functioning (Johnson and Berlin, 1974; Johnson and Curtis, 1978). Anderson and Kippelen reviewed the mechanisms and therapeutic approaches to exercise – induced broncho – construction induced by methacholine. Direct evidence indicating that Vitamin C affects exercise – induced broncho – construction (EIB) was found in three (3) small laboratory studies which the decreased forced expiratory volume *(*FEV) after exercise was attenuated by Vitamin C supplementation(Peter et al, 2008). Six (6) trials with participants under acute physical

stress indicate that Vitamin C has clinical important effects on the respiratory symptoms of some athletes although it is not clear to what degree that effect is directed at their infections and the physical injury to their airways (Hemila, 2008). This means that more trials that examine the mechanisms and therapeutic effects of Vitamin C (Ascorbic Acid) on the respiratory symptoms of athletes are warranted. Salbutamol, a sympathomimetic broncho – dilator with relatively selective effects on β_2 receptors by inhalation is the most commonly prescribed medication for bronchospasm and exercise – induced asthma, a clinical entity that affects about 10 to 20% of athletes, with an even higher prevalence in cycling and mountain biking(Collomp et al, 2000).

Since 1985, athletes have been allowed to take a few inhaled β_2 – agonists including Salbutamol (Sal), but systemic administration are currently banned by International Olympic Committee because of the concern that it may land on unfair competitive advantage to the users (Collomp, et al 2000). Moderate to heavy physical exercise greatly increases the amount of oxygen the skeletal muscle use. For example, a young man at rest utilizes about 250ML of oxygen per minute but maximal exercise may require 3,600ML of oxygen per minute (Gala, et al 1998). As oxygen utilization increases, the volume of carbon dioxide produced also increases. Because decreased blood oxygen and increase carbon dioxide concentrations stimulate the respiratory center, however, that blood oxygen and carbon dioxide concentrations usually do not change during exercise (Topulos, et al, 2000). This reflects the respiratory system's effectiveness in obtaining oxygen and releasing carbon dioxide to the outside. When breathing rate increases during exercise, increased blood flow is also required to power skeletal muscles. Thus, physical exercise places demands on both the circulatory and respiratory system (Syabbalo, 1998). If either of these systems fails to keep up with cellular demands, the person begins to feel out of breath. This feeling usually reflects inability of the heart and circulatory system to move enough blood between the lungs and cells, rather than the respiratory system's inability to provide enough air (West, 1990). Lung volume is a determinant of the vascular resistance in the pulmonary bed. The support of baseline absolute lung volumes on clinical decision – making is claimed not to be necessarily great (Walamies, 1998). However, the implication of pulmonary function defects on several clinical conditions can only but justify the value of the lung volume studies in clinical decision – making (Igneito et al, 1998; Yap et al, 2000; Cassino et al, 2000; Fuyita et al, 2001).

Hence, this research work is intended to envisage/ investigate the effect of Salbutamol in relation to ascorbic acid (Vitamin C) after the administration orally on the pulmonary performance of athletes.

MATERIALS AND METHOD

a. 100 Human subjects,
b. Spirometer, spirolab II AII MIR S/N A23 – 050.3550,
c. Nose Clip,
d. Methylated Spirit cotton wool,
e. Measuring Tape,

Scientia Africana, Vol. 16 (No. 2), December 2017. Pp 282-290
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

f. Weighing balance (Hana power bathroom scale,pese-personne,BR911),
g. A Structured Questionnaire/ Data Collection Sheet, I Recording Pen

Study Population

The study was carried out on athletes residing within port-Harcourt who gave their informed consent after explaining the rationale behind the research work and the ethical approval was given. The subjects were interviewed and physically examined with the use of relevant information (which included age, etc.) gotten from fill-up of the questionnaires. Those with respiratory and or cardiovascular disorders were excluded in the whole study. However, hundred (100) human subjects made up of twenty-five (25) males and females each ascorbic acid and salbutamol groups.

Measurement of peak flow rate

Measurement of peak expiratory flow rate was done using a DoTmed Spirolab II A\\ MIR spirometer S/N **A23-050.3550**. The subjects took a deep breath, applied his/her lip firmly to the mouth piece, expires as hard as fast as possible. The peak expiratory flow rate was obtained before and after drugs administration. Four readings were recorded per subjects

Spirometric measurement

The pulmonary function tests were carried out using DoTmed spirolab II A\\ MIR spirometer all pulmonary tests were done on subjects, seated in an upright position before and after one hour of the administration of the drugs (ascorbic acid and Salbutamol tablets) orally. All pulmonary tests were done on subjects, seated in an upright position. The Subjects were connected to the mouth piece and were asked to breath in order to familiarize with the equipment. A nose clip was applied during the entire process.

The parameters analyzed from the equipment were expiratory reserved volume (ERV), Inspiratory vital capacity (IVC), Inspiratory capacity (IC), and vital capacity (VC).

Anthropometrical measurement

The weights, heights of the subjects were taken using measuring tape, weighing scale while age and sex were recorded, body mass index (BMI) was calculated as weight (kg) divided by the square of the height in meters (m) kg/m2.

Drug administration

Ascorbic acid was given orally at a dose of 1.5 mg/kg body weight, and Salbutamol at dose of 70µg/kg body weight orally. Measurements were taken after one hour of the administration of the drugs.

Data analysis

The outcome of pulmonary function test was presented as a mean and standard deviation for each parameter. Chi-square was used to compare groups' results and values of less than 0.05 were considered as significant while confidence level was taken to be 95%.

RESULT

Table 1: Age, Height, Weight, Body Mass Index Data of subjects used in the study for both Male and Female for both group.

Anthropometric measurement	Group1 (Ascorbic Acid)		Group 2 (Salbutamol)	
	Male(mean)	Female	Male(mean)	Female
Age year	27.68±1.14	23.80±0.81	26.76±1.35	27.04±1.28
Height (cm)	164±3.30	157.9±3.21	167.6±1.54	162.52.±1.56
Weight (kg)	68.84±1.57	64.96±1.43	65.44±1.83	69,20±2.90
Body mass index(BMI) (kg/m^2)	26.52±1.79	27.24±1.85	26.40±1.01	22.82±0.69

Table 2: peak expiratory flow rate for both male and female in comparison before and after drug administration for the various group

Group1 (Ascorbic Acid)		Group 2 (Salbutamol)	
Male(mean)	Female	Male(mean)	Female
535.2±207.79	322.76±20.39	364.8±23.20	325.6±20.45
BEFORE ADMIN. OF DRUG			
450.6±51.45	290±34.90	318.±16.26	275.20±14.77

Table 3: Mean lung volumes and capacities after administration of ascorbic acid (group 1) and salbutamol (group 2)

Lung volume/capacity	Group1 (Ascorbic Acid)		Group 2 (Salbutamol)	
	Male(mean)	Female	Male(mean)	Female
Expiratory reserve volume (ERV)	1.36±0.48	1.29±0.68	1.30±0.21	1.25±0.59
Inspiratory capacity (IC)	2.56±0.26	3.04±0.54	2.46±0.12	2.12±0.13
Vital capacity (VC)	3.32±0.34	3.19±0.38	2.87±0.19	2.55±0.23
Inspiratory vital capacity (IVC)	3.67±0.14	3.16±0.24	3.56±0.14	3.12±0.18

Table 4: Before Administration of Drug

Lung volume/capacity	Group1 (Ascorbic Acid)		Group 2 (Salbutamol)	
	Male (mean)	Female	Male(mean)	Female
Expiratory reserve volume (ERV)	1.35±0.07	1.05±0.66	1.50±0.22	1.20±0.56
Inspiratory capacity (IC)	2.64±0.23	2.27±0.11	2.61±0.24	2.01±0.10
Vital capacity (VC)	2.46±0.41	2.65±0.34	2.91±0.20	2.23±0.24
Inspiratory vital capacity (IVC)	3.55±0.17	3.02±0.17	3.99±0.15	3.02±0.14

Scientia Africana, Vol. 16 (No. 2), December 2017. Pp 282-290
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

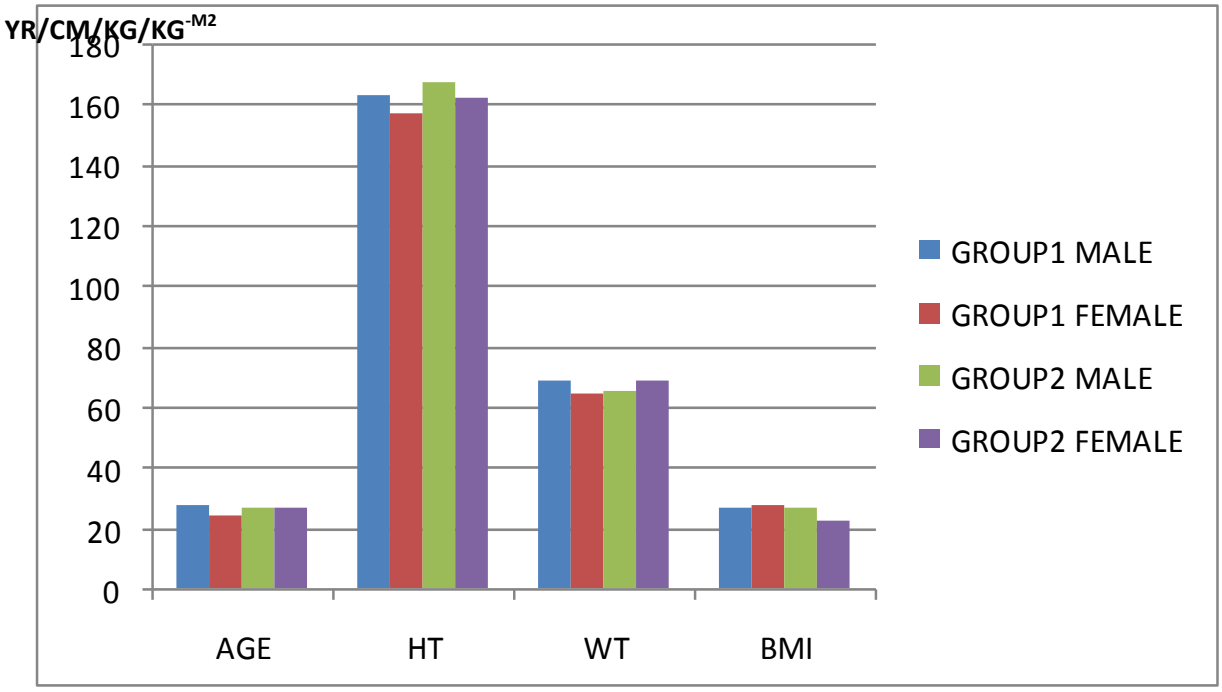

Figure 1: Shows a Graphical Representation of some Anthropometric Data of Subjects used in the study for both Male and Female for each category.

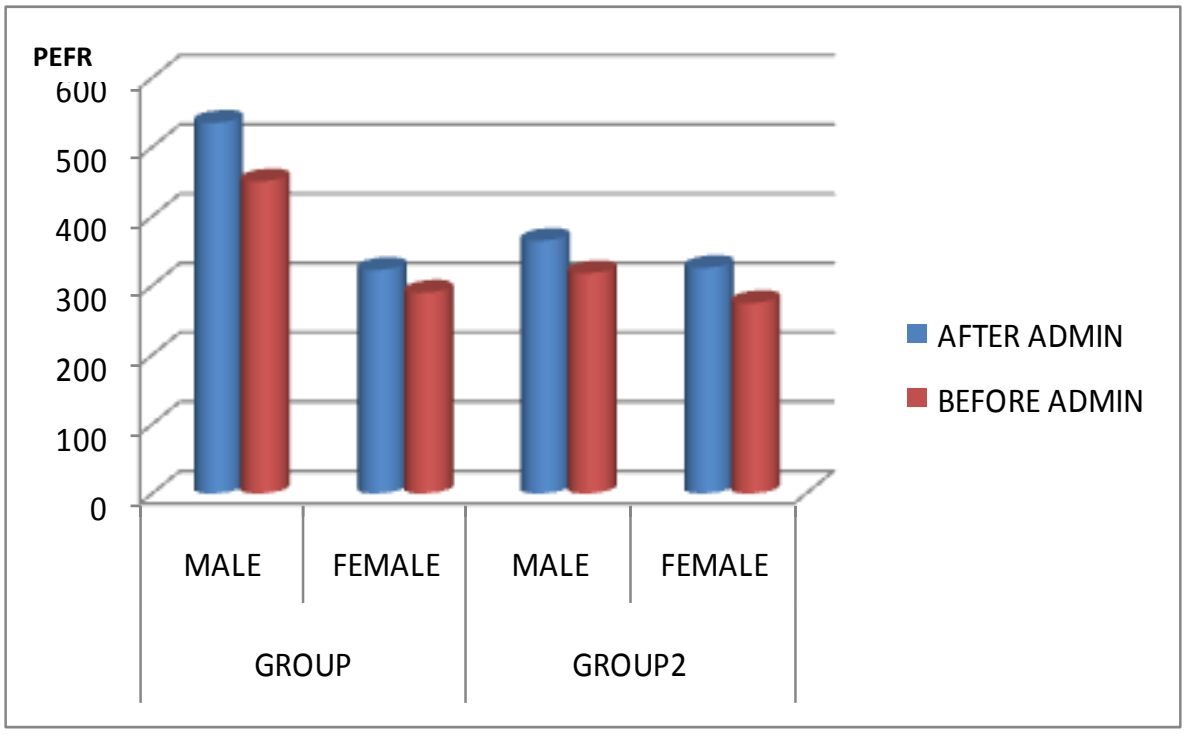

Figure 2: shows graphical representation of mean peak expiratory flow rate for both male and female in comparison before and after drug administration.

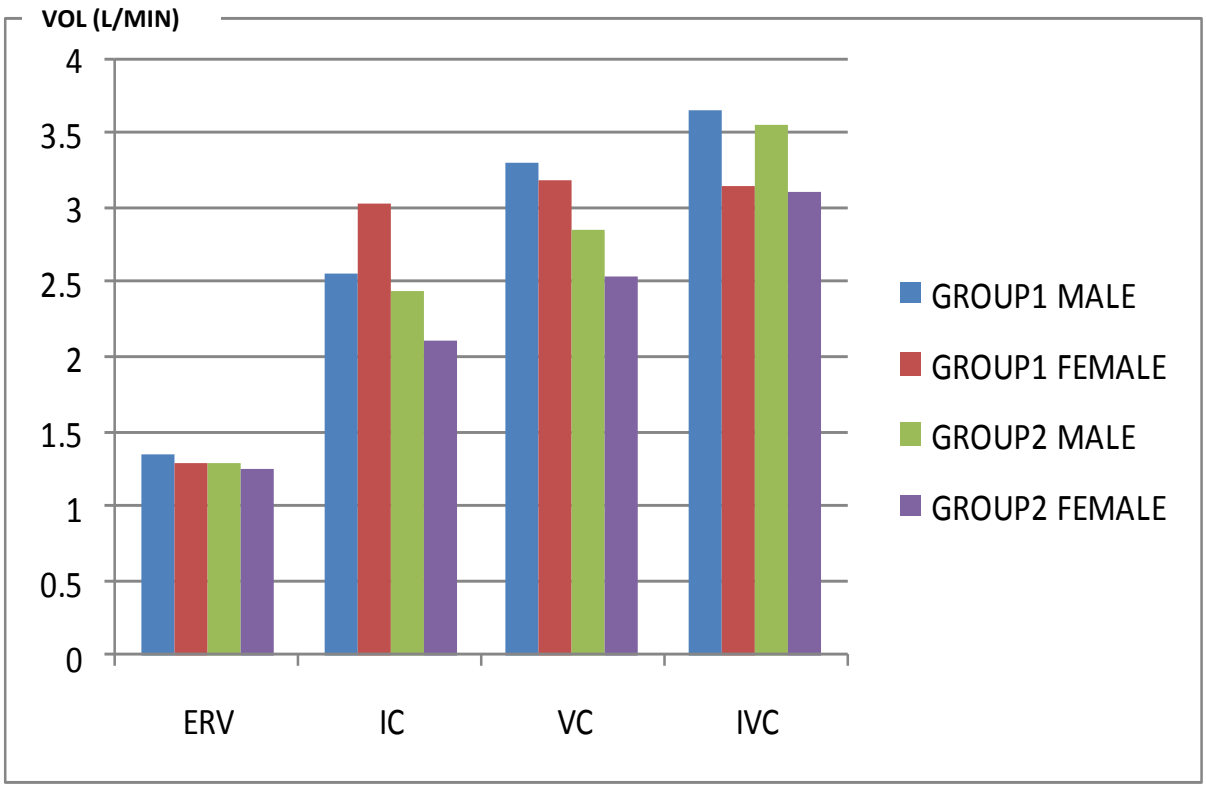

Figure 3: Shows Graphical representation of Mean Lung Volumes and Capacities following the administration of Ascorbic Acid and Salbutamol in comparison with control group

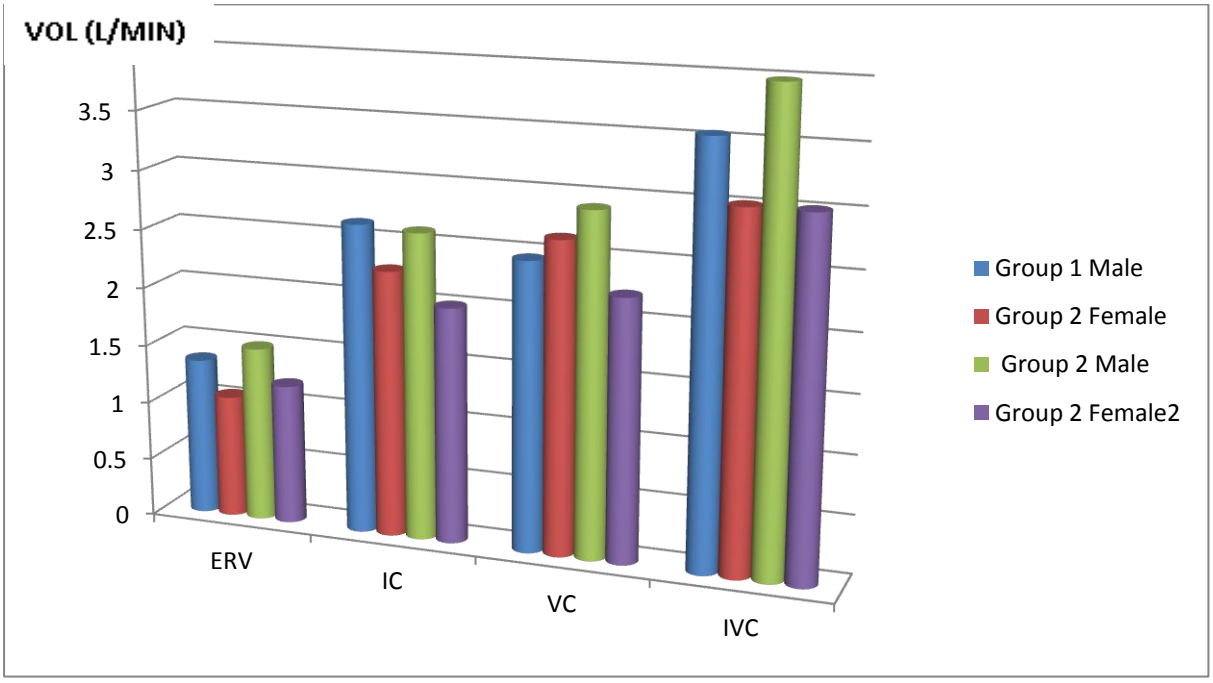

Figure 4: Mean lung volumes and capacities (Expiratory Reserve Volume, inspiratory capacity, vital capacity, inspiratory vital capacity) before the administration of ascorbic acid

Scientia Africana, Vol. 16 (No. 2), December 2017. Pp 282-290
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

DISCUSSION

This study has the male Peak Expiratory Flow Rate (PEFR) values are higher than female which is, 535.2±207.79 L/Min and 322.76±20.39 L/Min for male and female respectively for ascorbic acid (vitamin C), higher than any other group. In this study, PEFR value of 364.8 ±23.20L/Min is lower than this range. Ascorbic Acid enhanced the PEFR value to 535.2L/Min. This does not corroborate the study of Ibadin and Osubor (1999) which reported a lack of effect of vitamin C on pulmonary function. Vitamin C protect against loss of pulmonary function Hu et al, (1998), Grievmik et al, (1998) also supported the beneficial role of vitamin C in respiration dysfunction. The vitamin C effect shows a significant ($p<0.05$) increase in PEFR, indicating a minimal response of smooth muscle to sympathomimetics. Lands et al (1979) posited that the effect of B-adrenoceptor agonists actually become important in obstructive pulmonary disorders. Expiratory reserve volume (ERV) is higher for all the groups than standard values of 1.0L to 1.2L .Ascorbic Acid (vitamin C) increased ERV in both male and female (1.36±0.48 Land 1.29±0.68 L) respectively, there is a significant change compared with the standard values ($p<0.05$). Salbutamol group are 1.30±0.21 L and 1.25±0.59L for both sexes respectively. ERV reflects the thoracic and abdominal muscles strength, thoracic mobility and balance of elastic forces affecting spontaneous expiration (Gelb and Zamel, 2001). From the study, the subjects have high reserve expiratory abilities. This might be due to the fact that they are athletes, meaning they always engage in active regular bodily exercises. Inspiratory vital capacity (IVC) is higher than the ERV and IC and VC values in all the groups for male and female. showed an increased VC (2.46±0.41 L) for male in control group and deceased in salbutamol group, Ascorbic Acid also has high value of VC (3.32±0.34 L) for male which is significant ($p<0.05$). VC is usually reduced in severe respiratory muscle weakness (Syabbalo, 1998). Ascorbic Acid increases inspiratory Vital capacity (IVC) significantly in both sexes, all other group in study are lower than the ascorbic acid group for male and female respectively. IVC describes a balance between lung and chest elasticity, muscle strength and thorax mobility. Discrepancies in inspiratory vital capacity (IVC) and Expiratory reserve volume (ERV) may be explained by lack of parenchymal airway narrowing (Stanescu et at, 2000). The relatively lower values in females in the study correspond with the report that progesterone reduces fatigue and lowers exercise tolerance (Van-Haren et al, 1998) while Salbutamol corroborates with earlier studies (Pillet et al, 1998) which reported that B-agonist bronchodilators induce hypoxic vasoconstriction with no significant influence on ventilation parameters. This actually shows that Ascorbic Acid (vitamin C) indeed has beneficial effect on pulmonary function which means enhancement of performance of athletes.

Ascorbic Acid and Sympathominetics such as salbutamol are being used in the treatment of obstructive pulmonary disease following the Henry-Person's discovery of B-adrenoceptor selectivity (Lands et al, 1997). Since 1985, athletes have been allowed to take a few inhaled B2-againsts including salbutamol, but systemic administration is currently banned by the international Olympic committee because of the concern that it may lend an unfair competitive advantage to the users (collomp

et al, 2000). This study pea expiratory flow rate (PEFR) value. This does not correspond with the study of Ibadin and Osubor (1999) which reported a lack of effect of vitamin C on pulmonary function. The subjects have high reserve expiratory abilities; this might be due to the fact that they are athletes, meaning they always engage in active regular bodily exercise. The study showed an increased vital capacity for males in control group (non-athletes) and decreased in salbutamol group, ascorbic acid also has high value of vital capacity. This study shows inspiration capacity (ic) rising with ascorbic acid and following with salbutamol. It however collaborates with the fact that ascorbic acid protects against the loss of pulmonary function. (Hu et al, 1998). The relatively lower values in females in this study correspond with the report that progesterone reduces fatigue and lowers exercise tolerance (Hanren et al, 1998) while salbutamol corroborates with equire studies (Pillet et al, 1998) which reported that B-against bronchodilators induce hypoxic vasoconstriction with no significant influence on ventilation parameters. This actually shows that ascorbic indeed has beneficial effect on pulmonary function which means enhancement of performance of athletes. Ascorbic Acid increases pea expiratory flow rate (PEFR) much more than salbutamol. Expiratory reserve volume (ERV), Inspiratory capacity (IC), vital capacity (VC) and inspiratory vital capacity (IVC) were increased by Ascorbic Acid compared to salbutamol. This study shows that the performance enhancing role of Ascorbic Acid were more pronounced in males than females compared with salbutamol in athletes.

REFERENCES

Aderele, W.I and Oduwole, O. (1983) Peak expository flow rate in healthy school children. Nig. J. Paed. 10: 45 – 55.

Aggrarwal, A.N; Gupta; Behera D. and Jindal S.K. (2000). Analysis of static pulmonary mechanics help to identify functional defects in survivors of acute respiratory distress syndrome. Critical Care Medicine. 28 (10):

Collomp, K., Candau, R., et al (2000). Effects of short – term oral Salbutamol administration on exercise endurance and metabolism.

Eisen E.A., Wegmen, D.H., Louis, T.A., Smith, T.G. and Peter, J.M. (1995) Health worker effect in a longitudinal study of one – second forced expiratory volume (FEV) and chronic exposure to granite dust. Int. J. Epidemiology 24 (6): 1154 – 1161.

Fujita K; Shannon J.M.; Irvin C.G; Fagon K.A; Cool C; Augustin A. and Mason R.J. (2001) Over expression of tumour necrosis factor alpha produces an increase in lung volume and pulmonary hypertension. American Journal of Physiology, lung, cell, and Molecular Physiology 280 (1): L 39 – 49.

Galal M.W; Habib R.A; Jaeger D.D. and Lister G. (1998). Effects of rate amplitude of breathing on respiratory system elastic and resistance during growth of healthy children. Pediatric Pulmonology. 25 (4); 270 – 277.

Scientia Africana, Vol. 16 (No. 2), December 2017. Pp 282-290
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Gelb A.F. and Zamel N. (2000). Unsuspected pseudo physiologic emphysema in chronic persistence Asthma. American Journal of Respiration and Critical Care Medicine. 162 (5); 1778 – 1782.

Grievink L.; Smith H.A.; Ocke M.C. Van't – Veer P; Kromhout D. (1998). Dietry intake of antioxidant (pro) vitamins; respiratory symptoms and pulmonary function: the Morgen Study. Thorax. 53 (3):166 – 171.

Harri Hemila, MD, Ph.D (2008). Vitamin C and exercise – induced bronchoconstriction in athletes published online.

Hu G; Zhang X; Chen j; Peto R; Campbell T.C. and Cassino P.A. (1998). Dietry Vitamin C intake and Lung Function in rural China. American Journal of Epidemiology. 148 (6): 594 – 599.

Ibadin M.O. and Osubor C.C. (1999). Plasma Ascorbic acid status in Nigerian children with bacterial upper respiratory tract infection. Nigerian Medical Practitioner. 37 (1,2): 18 – 20.

Jaja, S.I and Fagbenro, A.O. (1995). Expiratory flow rate in Nigerians school children. African Journal Med. Med. Science, 24: 379 – 384.

Johnson, Z.M and Erasmus, L.D. (1968). Clinical spirometry in normal Bantu children. Am. Review of Resp. Dis. 97; 585 – 590.

Lands A.M; Arnold A; Mc – Auliff J.P Luduena F.P and Brown Jr T.G. (1967). Differentiation of receptor systems activated by Sympathomimetic amines. Nature, 214; 597 – 598.

Odeh, S.O; and I.E Agaba (2004) Pulmonary Performance in a symptomatic young Nigerian population following the administration of Ascorbic acid and Salbutamol. Nigerian Journal of Physiological Science 19 (1 – 2) 48 – 52.

Schwartz, J. and S.T Weiss (1994). Original research communications; Relationship between dietary vitamin C intake and pulmonary function in the first National Health and Nutrition Examination Survey (NHANESI), American Journal of clinical butrition, vol 59, 110 – 114.

Slonim N.B. and Hamilton L.H. (1987). Respiratory Physiology, 5th ed. The CV Mosby Company, Toronto pp 48 – 52.

Stanescu D; Veriter C; Van – de Woesstijine K.P. (2000). Maximal Inspiratory flow rates in patients with COPD. Chest 118 (4); 976 – 980.

Syabbalo N. (1998). Assessment of Respiratory Muscle Functions and Strength. Postgraduate Medical Journal, 74 (870); 208 – 215.

Topulos G.P; Brown R.E and Butler J.P, (2000). Influence of Lung Volume on Pulmonary micro vascular pressure – volume characteristics. Journal of Applied Physiology, 89 (4); 1591 – 1600.