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Acute effects of ultra-endurance cycling on the upper respiratory tract infection and lung function status among the professional and recreational cyclists

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Abstract
Acute ultra-endurance cycling efforts may induce high amounts of oxidative and inflammatory stress among the cyclists and if the adaptation to neutralize these effects are insufficient or if the oxidative and inflammatory stress are excessive and uncontrolled, could lead for inflammatory damage to the bronchial epithelial tissue and also could cause for the temporary suppression of immune strength leading to easier infections from pathogens of the respiratory tract. Upper Reparatory Tract Infections (URTIs) may be seen common among the people involve in the high intensity ultra-endurance physical activities. Two groups of cyclists, one professional and the other recreational cycling groups participated in the study, with hundred male cyclists in each, in the age range of 23 to 35 years. WURSS-44 questionnaire was used to quantify the URTI symptom scores of the subjects and the $FEV_1$was measured through digital spirometry for further analysis. The scores of the professional and recreational groups when analyzed indicated that there was significant difference both in in their URTI symptom scores and FEV_1scores, the Pre cycling URTI symptoms scores of the Professional and Recreational cyclists were 19.54 and 41.88, whereas the Post cycling URTI symptoms scores were 29.56 and 58.27. Pre cycling FEV_1 scores of the Professional and Recreational cyclists were 5.595 and 4.226, whereas the Post cycling FEV_1 scores were 5.2986 and 3.903. Covariance analysis indicated both variables showed significantly different as the F value was 6.62 (P=0.010819) for URTI symptom score and for FEV_1 was 39.48 (P=0.0001), and interaction for two-way factorial ANOVA was of 117.819, significantly high at P of <0.00. Acute ultra-cycling effort of the study brought significant reductions in the functional lung capacities of both the professional and recreational cycling groups of the study.

Keywords: Ultra endurance cycling, oxidative stress, inflammatory stress, upper respiratory tract infections, functional lung capacities

Introduction

Premise and introduction of the concept: Physical activities and exercise seems a part of the human culture and the human endeavor to be physically fit is an integral part of it, since time immemorial. These physical fitness and the health fitness are the two important ingredients that are associated with the physical exercises and sporting events, though may other emotional, psychological, sociological values are also attached. Sporting culture has initiated aggressive competitive spirit among the nations either to show the dominance or to exhibit the success as a symbol of excellence. Apart from this the individual competitiveness in the sporting scenario lead for the sporting science manifesting into a full blown science assisted by several other scientific disciplines. Sports science domains were extended from wellness studies to the elite performance studies, taking the inter disciplinary help from the disciplines like immunology, endocrinology, genetics, epigenetics, nutrition science including the nutria-genomics, medicine including sports medicine, physiology including exercise physiology, psychology, sociology etc. The spectrum of the sports sciences has changed so drastically that it encompasses almost all the scientific domains of the human endeavor. Sport is an instrument that would enhance the competitive edge, financial independence, global peace and health and various other human domains and hence now the sports science is very well studied across the globe and probably this caused for the extensive development of the exercise sciences during the recent times. Sports participation is viewed as an important element for enhanced health status apart from the other reasons mentioned hitherto.

Some of the sporting events are extremely intensive and enduring like marathon running, ultra endurance cycling, triathlons etc. These sporting events require excellent and outstanding physical and functional health from the participants. The cycling sport seems a very developed and most loved sporting event in Europe and in general in the world [15]. Long distance to very long-distance events like Tour De France, Tour De Spain are some of the very long-distance cycling events which are conducted over several days continuously before the winners are declared need extremely calculated scientific training and monitoring [8]. These events are continuous events for days, whereas there are several cycling events which are ultra-distance with one single effort [10]. These ultra-distance cycling evens maybe recognized as high intensity sustained aerobic events [16], though some portion of the anaerobic pathways are also utilized for energy. The fitness passion is developing among the general public across the globe and including among the Indians, and this lead for the revolution of mass events of marathon running, ultra distance cycling events even in India.

Studies from the exercise immunology indicate that the acute high intensity ultra-endurance physical activity may suppress the immunity temporarily, which some immunologists are mentioning as open window theory of immune suppression and this might cause for the easy proneness to the respiratory tract infections among the participants. This may be due to the combined effect of oxidative [25] and inflammatory stress due to the high intensity sustained physical activity like ultra-distance cycling [21] or other such extended high intensity exercise forms. Unaccustomed and uncontrolled oxidative and inflammation during such high intensity prolonged activities could cause for temporary suppression of immunity through the suppression in immune protein synthesis both of mucosal and cell mediated ones [9, 24]. Severe and high to very high intensity sustained physical activities may affect the metabolic pathways that would cause for the production of the immunoglobulin like IgA, IgG etc [1]. and also, lactoferrins, which act as a first line of defense against the invading pathogens especially at the bronchial tract [12]. Disturbances at the bronchial epithelial tissue through excessive inflammation might cause for the destruction of mucosal barrier [26] leaving space for the pathogens to invade the bronchial pathways leading to the both upper and lower respiratory infections.

The professional cyclists may be having better adaptation to such a high intensity sustained cycling efforts, but the recreational cyclists, who are taking part in such kind of cycling events may not be sufficiently adapted, due to their poor training protocols and other issues like recovery and nutrition etc [5, 27, 28]. There may be noticeable differences between the professional and recreational cyclists in terms of their anti-inflammatory and anti-oxidative capacities [6], which speak a lot when participating in such prolonged high intensity physical efforts. Scientific back and scientific training are highly essential during the training as well during the competitive efforts. Even the professional cyclist may be prone for certain respiratory illnesses, especially the Upper Reparatory Tract Infections (URTIs) due to minor flaws in recovery may be because of insufficient rest and nutrition changes. Sports nutrition support is highly essential for such high intensity sustained physical protocols [11, 29]. Recreational cyclists may be prone for URTIs due to their insufficient adaptation and lack of proper scientific monitoring in their training. Though sometimes, there may not be noticeable symptoms of URTIs among the professional cyclists, there may be changes in their lung function due to mucosal secretions affected from the pathogens, which need to be identified through the pulmonary function tests to monitor the lung function health of these cyclists. Compromised lung function could cause for the restrictions in the lung physiology with respect to the gaseous transfusion and the buffer mechanism that might negatively influence on the performances of even the very elite endurance cyclists [30].

Methodology: Two groups of cyclists were involved in this study. Hundred professional cyclists and hundred recreational male cyclists were responded for the study and participated in this study, which consisted of a questionnaire to quantify the URTIs symptoms and the digital spirometer to measure the intended lung capacities. Only those who acknowledged that they would respond for the lengthy questionnaire of the URTIs symptoms and also those who would send their digital spirometer measured lung capacity variables were only included for the study. The cyclists were asked to respond to the questionnaire one day before their ultra-endurance cycling effort of minimum of hundred and sixty kilometers and thereafter for five times starting from the lapse of forty eight hours for every twenty four hours. The ultra-endurance cycling effort may be their competition or their training, but done with proper high intensity that might be more than their sixty percent of the highest intensity possible individually, which would be monitored on their own or through their coaches etc. The criterion variables as already indicated are the Upper Respiratory Tract Infection symptom status which was measured through the Wisconsin Upper Respiratory Symptom Survey- 44(WURSS-44), which is very widely accepted among the pulmonology researchers across the globe and a highly credible questionnaire instrument, was developed by the Department of Family Medicine and Community Health of School of Medicine and Public Health of the University of Wisconsin, U.S.A. The questionnaire consisted of four dimensions of the URTIs symptoms, with a total of thirty two symptoms, quantified through the thirty two different questions, with objective answers to be selected by the subjects of the study, the score ranges from zero to seven for all the thirty two questions. Higher the total of the URTIs symptoms score through the WURSS-44, the URTI status was high and vice versa. To understand the corresponding lung health, the other criterion variable included for the study was the (Forced Expiratory Volume in the first second) FEV_1 value, which was measured through the digital spirometer technique. Analysis of Covariance (ANCOVA) was used to understand the variance between the professional and recreational runners pre and post URTI symptoms scores and also the FEV_1 scores and also Two way factorial analysis of variance (2X2 factorial ANOVA), to understand the association variance between the two criterion variables of the study *viz.* URTI score and FEV_1 for both the pre and post ultra-endurance cycling effort. The level of significance for the study was 0.05.

Analysis of results: Covariance analysis for URTI scores between professional and recreational cyclists: Table 1, shows that the Pre cycling URTI symptoms scores of the Professional and Recreational cyclists were 19.54 and 41.88, whereas the Post cycling URTI symptoms scores were 29.56 and 58.27. Covariance analysis as indicated in table 2, elicits that the pre and post URTI symptoms scores between the professional and recreational cyclists were significantly different as the obtained F was 6.62 (P=0.010819), which the test for homogeneity of regression for the URTI scores as

shown in table 3, was indicated that the baseline similarity between the groups. The graph 1 was depicted the pre, post and adjusted post cycling event means for the URTI symptoms scores of the professional and recreational cyclists groups of the study. The covariance analysis indicated that the professional cyclists group showed significantly lower URTI symptoms scores when compared to the recreational cyclists group of the study.

Table 1: Pre, Post and Adjusted Post cycling URTI score means

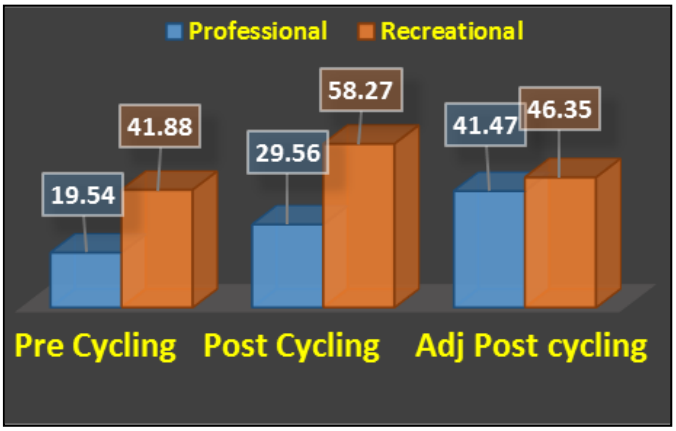
Means/ Groups	Pre-Cycling	Post cycling	Adjusted Post Cycling
Professional	19.54	29.56	41.47
Recreational	41.88	58.27	46.35

Table 2: ANCOVA table for URTI score

Source	SS	df	MS	F	P
Adjusted means	855.26	1	855.26	6.62	0.010819
Adjusted error	25467.46	197	129.28		
Adjusted total	26322.72	198			

Table 3: Test for homogeneity of regression for URTI scores

Source	SS	df	MS	F	P
Between regressions	9.85	1	9.85	0.08	0.777596
Remainder	25457.61	196	129.89		
Adjusted error	25467.46	197			



Graph 1: Pre, Post and Adjusted Post cycling URTI score means

The covariance analysis for the Pre and Post cycling effort FEV_1 scores between the Professional and recreational cycling groups as indicated in table 4, elicits that the Pre cycling FEV_1 scores of the Professional and Recreational cyclists were 5.595 and 4.226, whereas the Post cycling FEV_1 scores were 5.2986 and 3.903. Covariance analysis as indicated in table 5, elicits that the pre and post FEV_1 scores between the professional and recreational cyclists were significantly different as the obtained F was 39.48 (P=0.0001), which the test for homogeneity of regression for the FEV_1 scores as shown in table 6, was indicated that the baseline similarity between the groups. The graph 2 was depicted the pre, post and adjusted post cycling event means for the FEV_1 scores of the professional and recreational cyclists groups of the study. The covariance analysis indicated that the professional cyclists group showed significantly higher FEV_1 scores when compared to the recreational cyclists group of the study. However, the mean analysis indicated that the post cycling FEV_1 scores got decreased significantly for both the recreational and professional cyclists, the recreational cyclists being the more affected group of the study.

Table 4: Pre, Post and Adjusted Post cycling FEV_1 score means

Means/ Groups	Pre-Cycling	Post cycling	Adj Post
Professional	5.595	5.298	4.783
Recreational	4.226	3.903	4.418

Table 5: ANCOVA table for FEV_1 score

Source	SS	df	MS	F	P
Adjusted means	1.91	1	1.91	39.48	<.0001
Adjusted error	9.51	197	0.05		
Adjusted total	11.41	198			

Table 6: Test for homogeneity of regression for FEV_1 scores

Source	SS	df	MS	F	P
Between Regressions	0.16	1	0.16	3.27	0.072090
Remainder	9.35	196	0.05		
Adjusted error	9.51	197			

Graph 2: Pre, Post and Adjusted Post cycling FEV_1 score means

The two way factorial analysis of variance for the two related criterion variables, the URTI symptom scores and the FEV_1 scores of the two groups as indicated in table 6, elicits that the obtained F of 294.297 was significantly high at P of <0.001 indicating that the within the group effect of the URTI symptom scores of the group was significantly different between the pre cycling and post cycling event. The table indicated F of 117.819 was significantly high at P of <0.001 indicating that the within the group effect of the FEV_1 scores of the group was significantly different between the pre cycling and post cycling event. The table also indicated F of 134.194 was significantly high at P of <0.001 indicating that the interaction effect between the URTI symptoms score and the FEV_1 scores of the group was significantly different between the pre cycling and post cycling event indicating that the URTI symptoms may influence on the criterion lung capacity of the study. The descriptive statistics indicated in table 7 elicits that the professional cyclists group showed a pre cycling mean of 19.54 for the URTI symptoms and an enhanced Post cycling mean of 29.56 for the URTI symptoms. Also, the professional cyclists group showed a pre cycling mean of 5.5955 for FEV_1 and showed a reduced FEV_1 post cycling mean of 5.2988. The same has been indicated in the graph 3.

Table 7: Descriptive statistics for URTI and FEV_1 of Professional cyclists

Means for Cells, Rows, Columns, and Total			
	B1	B2	Totals
A1	19.54	29.56	24.55
A2	5.5955	5.2988	5.44715
Totals	12.56775	17.4294	14.998575

Table 8: ANOVA (2X2 repeated measures) on URTI and FEV_1 of professional cyclists

ANOVA Summary 2rows x 2columns					
A = row variable B = column variable Subj = subjects					
Source	SS	df	MS	F	P
Subjects	11132.53	99			
Within Subjects					
A	36491.88	1	36491.88	294.297	<.0001
Subj x A	12275.65	99	123.9965		
B	2363.56	1	2363.56	117.819	<.0001
Subj x B	1986.026	99	20.0609		
A x B	2660.85	1	2660.85	134.194	<.0001
Subj x A x B	1963.002	99	19.8283		
Total	68873.52	399			

Graph 3: Pre and Post cycling means for URTI and FEV_1 scores of Professional cyclists

Discussion on Results: The statistical analysis of the results of the present study clearly indicate that the Upper respiratory tract infections may be quantified through the symptom quantification and the same may be correlated to the performance of the ultra-distance cycling or the ultra-distance cycling efforts due to their high and uncontrolled inflammatory and oxidative stress could induce the respiratory tract infections, especially the upper respiratory tract infections[13]. The covariance results indicated that both the professional and recreational runners are alike in getting affected negatively through the acute ultra-endurance cycling effort and experienced significant increments in their upper respiratory tract infection symptom episodes, though the recreational runners seem more severely affected in this regard when compared to the professional cyclists. The reasons for this difference may be due to the differences in the levels of functional physiological fitness, adaptation to the high levels of oxidative and inflammatory stress through better endogenous anti-oxidative and anti-inflammatory mechanisms[14] among the professional cyclists. Insufficient adaptation and excessive acute aerobic efforts during the acute ultra-cycling efforts by the recreational runners may be the probable reason for experiencing the higher episodes of URTIs and the higher URTI symptom score. Upper respiratory tract infections may not be present in isolation without having any effect on the lower and other respiratory apparatuses of the lungs. Since, the observation and quantification of the URTIs is easier, there were several quantification techniques been developed by the pulmonology scientists. The possibility of the whole lung being affected due to the URTIs may not be completely ignored and hence it would be ideal to verify and to monitor the whole lung functional health of the elite cyclists especially those who participate in the events like Tour de France [8, 23], where in the cyclists are expected to ride hundreds of kilometers every successive day for almost twenty days continuously[18]. Loss in lung function due to the respiratory tract infections could be very fatal for such professional cyclists and hence need to be very careful in protecting the lung health through proper means of rest and recovery like proper nutritional supplementation etc [2]. Even the recreational cyclists are very much essential to monitor their lung health [17] as frequent infections to the respiratory tract may be fatal in the long run, as the same may lead for some permanent and chronic changes in the respiratory functional health leading to exercise induced asthma or obstructive conditions in the lungs.

Lung health of the individuals may be understood through measuring and analyzing the various lung capacities through digital spirometry [19]. As the improved digital spirometry gives more precise measures for the various lung capacities, the present study analyzed one selected lung capacity, i.e. FEV_1 (Forced Expiratory Volume of air in the first second of the effort) to analyze the possible relationship between the URTI episodes and the functional lung capacity [7], that might reflect on the cardio vascular efficiency of the cyclists or reflects on the capacity of the high intensity ultra-endurance cycling effort. Lung capacities of the individuals may be negatively impacted if there are any obstruction or else any other functional disturbances that may obstruct the gases transport and the buffer mechanism of the lungs. The results of the present study indicated that there was significant reduction in the FEV_1 value of both the professional and recreational cyclists due to the acute ultra-cycling effort of the study, indicating possible negative effect on the prospective performance of the professional cyclists or health of the recreational cyclists. Further analysis also indicated, that the changes in the URTI symptom scores may also be corelated to the reduction in the FEV_1value of both the professional and recreational cyclists [20], and this infers that the upper respiratory tract infections could induce possible negative influence on the lung physiology [3] and could induce for reductions in the functional lung capacities and thereby affecting the performance of the cyclists [22] of both professional and recreational alike [4] but also may affect the lung health of both the types of cyclists.

Conclusion from the study: Acute ultra-endurance cycling efforts could induce severe levels of oxidative and inflammatory stress in various tissues of the cyclists, especially the respiratory tissues causing physiological damage to the integrity of the epithelial tissue of the bronchial tracts and also might cause the severe immune suppression which may impact on the possibility of getting infected from pathogens like virus, bacteria etc. during the period of immune suppression and would cause for the reductions in the functional health of the lungs causing significant changes in the lung capacities, which may also affect negatively the ultra-endurance performances and training among both the professional and recreational cyclists alike. The recreational cyclists need to be more serious in their preparation and participation of such acute ultra-endurance cycling events and it would be ideal to have high levels of adaptations for such efforts.

References

1. Adriele V Souza, Jéssica S Giolo, Renata R Teixeira, Danielle D Vilela, *et al*. Salivary and Plasmatic Antioxidant Profile Following Continuous, Resistance, and High-Intensity Interval Exercise: Preliminary Study, Oxid Med Cell Longev 2019;26:2019:5425021.

2. Alessandro Pingitore. Giuseppina Pace Pereira Lima, Francesca Mastorci et.al. Exercise and Oxidative Stress: Potential Effects of Antioxidant Dietary Strategies in Sports, Nutrition. Jul-Aug 2015;31(7-8):916-22.
3. Andréanne Côté, Julie Turmel, Louis-Philippe Boulet. Exercise and Asthma, Semin Respir Crit Care Med 2018;39(1):19-28.
4. Antonio Jose Grande, Justin Keogh *et al*. Exercise Versus No Exercise for the Occurrence, Severity, and Duration of Acute Respiratory Infections, Cochrane Database Syst Rev 2020;4(4):CD010596.
5. Anu Elisa Koivisto, Thomas Olsen, Ingvild Paur, Gøran Paulsen, *et al*. Effects of Antioxidant-Rich Foods on Altitude-Induced Oxidative Stress and Inflammation in Elite Endurance Athletes: A Randomized Controlled Trial, PLoS One 2019;14(6):e0217895.
6. Arne Sørensen, Tore Kristian Aune *et al*. The Validity of Functional Threshold Power and Maximal Oxygen Uptake for Cycling Performance in Moderately Trained Cyclists, Sports (Basel) 2019;7(10):217.
7. Ayla Çağliyan Türk, Sertaç Arslan, Yusuf Karavelioğlu, *et al*. Pulmonary Function, Aerobic Capacity and Related Variables in Patients With Ankylosing Spondylitis, Arch Rheumatol 2019;34(3):317-325.
8. Bent R Rønnestad, Joar Hansen. A Scientific Approach to Improve Physiological Capacity of an Elite Cyclist, Int J Sports Physiol Perform 2018;13(3):390-393.
9. Bhumika Aggarwal, Aruni Mulgirigama, Norbert Berend. Exercise-induced Bronchoconstriction: Prevalence, Pathophysiology, Patient Impact, Diagnosis and Management, NPJ Prim Care Respir Med 2018;28(1):31.
10. CP Earnest, R Jurca, TS Church, *et al*. Relation Between Physical Exertion and Heart Rate Variability Characteristics in Professional Cyclists During the Tour of Spain, Br J Sports Med 2004;38(5):568-75.
11. Chad M Kerksick, Shawn Arent, Brad J Schoenfeld, Jeffrey R Stout, Bill Campbell, Colin D Wilborn, *et al*. International Society of Sports Nutrition Position Stand: Nutrient Timing, J Int Soc Sports Nutr 2017;14:33.
12. DC Nieman, DA Henson, CL Dumke, *et al*. Relationship Between Salivary IgA Secretion and Upper Respiratory Tract Infection Following a 160-km Race, J Sports Med Phys Fitness 2006;46(1):158-62.
13. Danit Atias-Varon, Yuval Heled. strenuous and prolonged exercise and upper respiratory tract infection - treatment or threat? Harefuah 2017;156(11):730-734.
14. Elisabet Cantó, Emma Roca, Lidia Perea, Ana Rodrigo-Troyano, *et al*. Salivary immunity and lower respiratory tract infections in non-elite marathon runners, PLoS One 2018;13(11):e0206059.
15. Erik W Faria, Daryl L Parker, Irvin E Faria. The Science of Cycling: Physiology and Training - Part 1, Sports Med 2005;35(4):285-312.
16. G Neumayr R Pfister, G Mitterbauer, *et al*. Exercise Intensity of Cycle-Touring Events, Int J Sports Med 2002;23(7):505-9.
17. Günther Neumayr, Hannes Gänzer, Wolfgang Sturm, *et al*. Physiological effects of an Ultra cycle ride in an amateur athlete – a case report. J Sports Sci Med 2002;1(1):20-26.
18. HG Ferrari, CA Gobatto, FB Manchado-Gobatto. training load, immune system, upper respiratory symptoms and performance in well-trained cyclists throughout a competitive season, Biol Sport 2013;30(4):289-294.
19. Medelli J, Lounana J, Messan F. Testing of Pulmonary Function in a Professional Cycling Team, J Sports Med Phys Fitness 2006;46(2):298-306.
20. James H Hull, Les Ansley, *et al*. Eucapnic Voluntary Hyperpnea: Gold Standard for Diagnosing Exercise-Induced Bronchoconstriction in Athletes? Sports Med 2016;46(8):1083-93.
21. John D Brannan, James A Turton. The Inflammatory Basis of Exercise-Induced Bronchoconstriction, Phys Sportsmed 2010;38(4):67-73.
22. Jose A Rodríguez-Marroyo, José G Villa, *et al*. Decrement in Professional Cyclists' Performance After a Grand Tour, Int J Sports Physiol Perform 2017;12(10):1348-1355.
23. Jose A Rodríguez-Marroyo, Raúl Pernía, *et al*. Reliability and Seasonal Changes of Submaximal Variables to Evaluate Professional Cyclists, Int J Sports Physiol Perform 2017;12(10):1356-1362.
24. Tuesta M, Alvear M, Carbonell *et al*. Effect of Exercise Duration on Pro-Oxidants and pH in Exhaled Breath Condensate in Humans, J Physiol Biochem 2016;72(2):353-60.
25. Kakanis MW, Peake C, Brenu EW, Simmonds M, *et al*. The Open Window of Susceptibility to Infection After Acute Exercise in Healthy Young Male Elite Athletes, Exerc Immunol Rev 2010;16:119-37.
26. Mariana Couto, Diana Silva, *et al*. Exercise and Airway Injury in Athletes, Acta Med Port. Jan-Feb 2013;26(1):56-60.
27. Nanci S. Guest, Justine Horne, Shelley M. Vanderhout and Ahmed El-Sohemy. Sport Nutrigenomics: Personalized Nutrition for Athletic Performance, Frontiers in Nutrition, February 2019;6:8. doi: 10.3389/fnut.2019.00008.
28. Neil P Walsh. Recommendations to Maintain Immune Health in Athletes, Eur J Sport Sci 2018;18(6):820-831.
29. Oliver C Witard, James E Turner, Sarah R Jackman, *et al*. High Dietary Protein Restores Overreaching Induced Impairments in Leukocyte Trafficking and Reduces the Incidence of Upper Respiratory Tract Infection in Elite Cyclists, Brain Behav Immun 2014;39:211-9.
30. Rajasekhar Kali Venkata Acute cycling sport causes upper respiratory tract infections and lung function loss among male recreational cyclists of different age groups. Journal of Science & cycling 2014;3(2).