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Effect of Competitive Marathon running on the Upper Respiratory Tract Infection Status and Lung Function ($FEV_{1)}$ of Professional and Recreational Runners

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Abstract

Introduction: Exercise immunology studies are providing increasing evidence about the effect of high intensity extended aerobic activity on the mucosal immunity and respiratory tract infection status and loss of lung function. This study investigated the effect of competitive marathon running on the Upper Respiratory Tract Infection status and consequent loss of lung function taking FEV_1 among the professional and recreational runners. Methodology: Thirty volunteer professional men runners and thirty recreational men runners who participated in different marathon competitions were included. Their URTI status was measured through Wisconsin Upper Respiratory Symptom Survey (WURSS-21) and FEV_1 though the digital spirometer, once before the event day and four times after the event once in each day. Results and discussion: Analysis of Variance (<0.05) indicated that for both URTI status and FEV_1 values, there was significant difference both among professional runners and recreational runners. Mean and Tukey Post Hoc analysis indicated professional runners experienced significant increase in URTI on the third day (53.8 compared to 17.533) after marathon, where as the recreational runners experienced significant increase in their URTI on the second (71.066) and third (84.33) days after the marathon running. FEV_1 decrements for professional runners was constant on every day, the maximum was on the fourth day with 84.76, whereas in recreational runners the FEV_1 decrements were also constant and lowest FEV_1 recorded was on the fourth day (77.27). The results also indicated that the FEV1 value difference between the third and fourth day for professional runners was not significant and this indicates the professional runners started recovering on the fourth day, whereas this is not observed for the recreational runners indicating their recovery is late. Conclusions: Both professional and recreational runners would get affected on competitive marathon running on their URTI and also experience loss in lung function (FEV_1), though the professional runners would tend to recover earlier when compared to the recreational runners from the URTI and loss of lung function.

Keywords: Mucosal Immunity, Upper respiratory tract infection, marathon running, lung function.

Introduction

Evidences in exercise immunology testify the immunosuppressive effect of heavy and very high intensity prolonged exercise (Gleeson M, Bishop N, et.al. 2013). There have been observations, that though exercise per se has been recognised as health booster and protects immunity system, leading to resistance to diseases, evidences are there to confirm certain instances of immunosuppression leading to respiratory tract infections among elite athletes also, due to very high intensity exercise protocols. An open window theory of temporary immunosuppression (Kakanis MW, Peake J, Brenu EW, et.al. 2010) among individuals who involve in high intensity endurance training, like acute marathon running indicates that such individuals are prone to infections as they are under temporary state of immune-suppression due to suppression of different immunoglogulins in their mucosal secretions. This phenomenon of immune-suppression among high intensity endurance activity individuals is associated with increase in Upper Respiratory/Tract Infections (URTI). Whenever, intensified training is undertaken by even elite athletes, there could be possibility of immune-suppression leading to respiratory infections and disturbances in their training. Apart from this risk of loss of training, sportsmen also may be prone to risk of secondary infections leading to further complications. Increase in antigen challenge and consequent abnormal increase in anti-inflammatory cytokine appearance, could be the cause of this state of URTI among high intensity endurance activity participants, like acute marathon running. It has become a major concern over the recent years that the negative impact on the immunity of the individuals who involve in high intensity and extreme physical activities like half marathon, marathon running, triathlon etc (Walsh NP, Gleeson M, Shephard RJ, Gleeson M,et.al. 2011). Oral cavity immune system is a part of the total immune system of individuals, as this immunity which is regulated by antimicrobial proteins (AMPs). These may be non specific enzymatic substances like lysozyme, lactoferrin and perioxodases and specific elements of immune system like various types of immunoglobulins. The saliva contains various specific and non specific immunological components that are antibacterial, antiviral and antimycotic or antifungal in their activities. Exercise immunology is focusing on the effects of different forms of physical activities and exercise forms with different forms and different durations as different forms and different intensities of exercise might impose different stress and demands different cytokine (Matthews CE, Ockene IS, Freedson PS, et.al. 2002)environment as challenge to antigens. Several studies supported the concept that the immune-suppression due to excessive involvement in exercise programs due to elite competitions (Gleeson M, Williams C. 2013). It may be the suppression of resting levels of antimicrobial proteins like Salivary lactoferrin, lysozyme, peroxidases and even the specific immunological substances like Immunoglobulin A etc which lead to the increase of Upper Respiratory Tract Infectins(URTIs) among the highly trained athletes and sportsmen especially during the high competitive period or during the high intensity training periods. This would cause

disturbances in the athletes' schedule of training leading to loss of form and injuries (Ahmadinejad Z, Alijani N, et.al.2014). The immune-suppression due to exercise involvement needs more scrutiny with different combinations of exercises and different individuals (Moreira A, Delgado L, et.al. 2009). Especially keeping the intensified increase in recreational running across the globe, exercise immunologists are interested to know the specific effects of acute bouts of high intensity aerobic exercise like marathon running on the URTI symptoms and causes. Sometimes, it also happen that latent effect of URTI could cause for loss of endurance capacity even among the elite athletes causing unnoticed loss of form. Hence, the present study focused on the effect of competitive high intensity marathon running on the URTI symptoms and consequent possible loss of lung function both among well trained professional runners and recreationally trained runners.

Methodology

Thirty volunteer professional men runners and thirty recreational men runners who participated in different marathon competitions were included after obtaining their consent to be included and were also explained about their precise cooperation. Their URTI status was measured through Wisconsin Upper Respiratory Symptom Survey (WURSS-21) and Forced Expiratory Volume in first second ($FEV_{1)}$ though the digital spirometer, once before the event day and four times after the event once in each day. The WURSS scores were for URTI symptom status and scores were collected both before and every day after the marathon event was over till the scores indicated recovery. Since, all the sixty runners were from the city of Hyderabad, all the participants were perfectly monitored and the FEV_1 values were measured one day before the marathon running and also daily after the event until the FEV_1 values showed recovery. Both URTI and FEV_1 scores of the individuals were analysed with the help of analysis of variance (ANOVA) with 0.05 level of significance. Tukey HSD post hoc comparison was done to understand the source of significant difference and to compare to explain the effect of the marathon running on the URTI symptom status and FEV_1 status of the professional and recreational runners of the study.

Table I. *Mean and Variance Analysis for Professional Runners URTI Status*

	Pre Race	Post 1st day	Post 2nd day	Post 3rd day	Post 4th day
Mean	17.5	25.3	32.34	53.8	46.8
Variance	193.5	173.8	394.81	1152.46	811.89
Std. Dev	13.91	13.18	19.87	33.95	28.49
Std. Error	3.59	3.4	5.13	8.76	7.36

Table II. *Analysis of Variance for Professional Runners URTI Status*

Source	SS	df	MS	F	P
Treatment (between groups)	13472.8	4	3368.2	24.2	<.0001
Error	7784.72	56	139.01		
Ss/Bl	30386.4	14			
Total	51644.0	74			

Figure I.

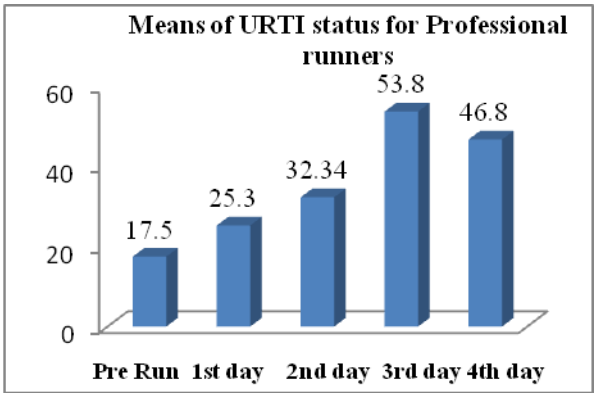

Table III. *Tukey HSD Post Hoc Analysis. For Professional URTI Status(0.05 = 12.15)*

URTI Means	1st day 25.34	2nd day 32.34	3rd day 53.8	4th day 46.8
Pre run 17.533	7.81 N. Sig	14.81 Sig	36.27 Sig	29.27 Sig
1 day 25.34	-	7 N. Sig	33.46 Sig	21.46 Sig
2nd day 32.34	-	-	21.46 Sig	14.4 Sig
3rd day 53.8	-	-	-	7 N. Sig

Results

Analysis on URTI status: Mean values of URTI status of professional runners of the study showed steady increase (fig. I) when compared to the pre race value (17.5). Professional runners experienced steady raise in their URTI symptom status and was peak on the third day (53.8) but showed recovery on the 4th day (46.8). Analysis of variance (Table II), at 0.05 level of significance showed that the URTI symptom scores of the professional runners are significantly different ($F = 24.2$, $p < 0.0001$) from the pre race scores, indicating the professional runners are prone for significantly increased URTI symptoms. Tukey HSD post hoc comparison at 0.05 level of significance (Table III) revealed that the professional runners started

experiencing the significant increase in the URTI symptoms from the 2nd day (32.34) and continued to experience significant increment on 3rd day (53.8), but experienced recovery from the symptoms with reduced URTI score (46.8) on the fourth day, though the score on the fourth day was still significantly high when compared to the Pre race URTI symptom score. Recreational runners also experienced continuous increments in their URTI symptom scores (fig. II) when compared to the pre race URTI symptom scores (Table VI). Analysis of variance (table V) indicates that the recreational runners URTI symptom scores are also significantly different (F = 40.5, P = <0.0001) when compared to their pre marathon running scores. Recreational runners also experienced the increments in their URTI symptom scores in a similar manner to the professional runners and experienced highest score on the third day (84.3) after the race, with recovery URTI symptom score (66.47) on the fourth day. But, in comparison, recreational runners experienced much higher URTI symptom scores when compared to the professional runners. This clearly indicates that the recreational runners were more prone to URTI symptoms when compared to the professional runners due to acute high intensity marathon running. Both professional runners and recreational runners started recovering from the URTI symptoms from the fourth day after the high intensity marathon running. The Tukey HSD post hoc comparison at 0.05 level of significance, recreational runners showed significant increments in their URTI symptoms post the marathon running from from first day onwards and this shows that the recreational runners of the study were much easier to Upper respiratory tract infection symptoms, when compared to the professional runners due to the high intensity competitive marathon running. Even the recovery from the third day URTI symptoms to the fourth day URTI symptoms is not significant (4.59) showing that though the sign of recovery was there for also to recreational runners, the recovery was not significant.

Figure II

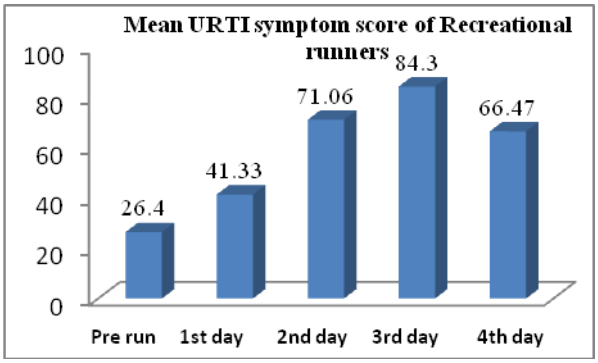

Table VI. *Tukey HSD Post Hoc Analysis. For Recreational URTI Status (0.05 = 14.74)*

URTI Means	1st day 41.33	2nd day 71.06	3rd day 84.3	4th day 66.47
Pre run 26.4	14.93 Sig	44.66 Sig	57.9 Sig	40.07 Sig
1 day 41.33	-	29.73 Sig	42.97 Sig	25.14 Sig
2nd day 71.06	-	-	13.24 N. Sig	4.59 N. Sig
3rd day 84.3	-	-	-	17.83 Sig

Analysis on FEV_1 status

Mean values of the FEV_1 of Professional runners of the study decreased steadily for all the four days measured (fig. III), the lowest was recorded on fourth day (84.76) after the marathon racing day. Analysis of variance (table VIII) indicated that the professional runners experienced significant decrements in their FEV_1 value (F= 40.5, p = <0.001), during the four days after the marathon running. Tukey HSD post hoc comparison at 0.05 level of significance among the means, revealed that the professional runners experienced significant and continuous decrements in their FEV_1 value when compared to the pre marathon running FEV_1 value. Whereas, the difference between the third day and fourth day FEV_1 was not significant among the professional runners of the study. Mean values of the FEV_1 of recreational runners of the study decreased steadily for all the four days measured (fig. III), the lowest was recorded on fourth day (77.27) after the marathon racing day. Analysis of variance (table VIII) indicated that the recreational runners of the study experienced significant decrements in their FEV_1 value (F= 218.14, p = <0.001), during the four days after the marathon running.

Table VII. *Mean and Variance Analysis for Professional Runners FEV_1 Status*

	Pre Race	Post 1st day	Post 2nd day	Post 3rd day	Post 4th day
Mean	88.83	88.22	86.54	85.24	84.76
Variance	14.15	16.11	16.28	14.47	14.43
Std. Dev	3.76	4.01	4.035	3.8	3.79
Std. Error	0.97	1.036	1.041	0.98	0.98

Table VIII. *Analysis of Variance for Professional Runners FEV_1 Status*

Source	SS	df	MS	F	P
R	191.021	4	47.75	40.5	<.0001
Error	17.702	56	204.49		
Ss/Bl	1038.62	14			
Total	1247.34	74			

Figure III.

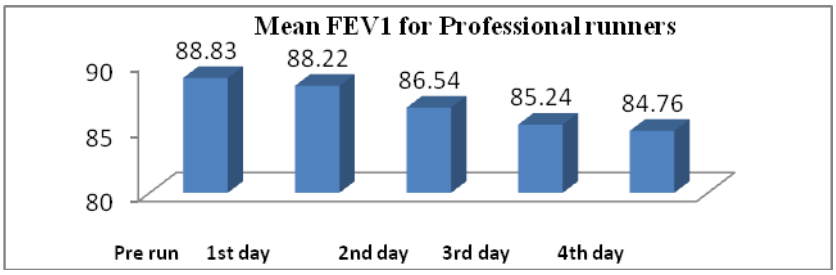

Table IX. *Tukey HSD Post Hoc Analysis. For Professional FEV_1 Status (0.05 = 0.58)*

URTI Means	1st day 88.22	2nd day 86.54	3rd day 85.24	4th day 84.76
Pre run 88.83	0.613 Sig	2.293 Sig	3.587 Sig	4.06 Sig
1 day 88.22	-	1.68 Sig	2.97 Sig	3.45 Sig
2nd day 86.54	-	-	1.29 Sig	1.77 Sig
3rd day 85.24	-	-	-	0.479 N. Sig

Table X. *Mean and Variance Analysis for Recreational Runners FEV_1 Status*

	Pre Race	Post 1st day	Post 2nd day	Post 3rd day	Post 4th day
Mean	83.91	83.46	82.32	80.81	77.27
Variance	15.82	15.4	14.32	14.37	12.09
Std. Dev	3.97	3.92	3.78	3.7	3.47
Std. Error	1.027	1.013	0.977	0.98	0.9

Table XI. *Analysis of Variance for Recreational Runners FEV_1 Status*

Source	SS	df	MS	F	P
Treatment (between groups)	430.26	4	107.56	218.14	<.0001
Error	27.613	56	0.493		
Ss/Bl	980.78	14			
Total	1438.66	74			

Tukey HSD post hoc comparison at 0.05 level of significance, among the means revealed that the recreational runners experienced significant and continuous decrements in their FEV_1 value when compared to the pre marathon running FEV_1 value. Whereas, the difference between the recreational runners of the study experienced reductions in their FEV_1 value from third day to the fourth day also, indicating much longer time requirement for recreational runners to recover.

Figure IV

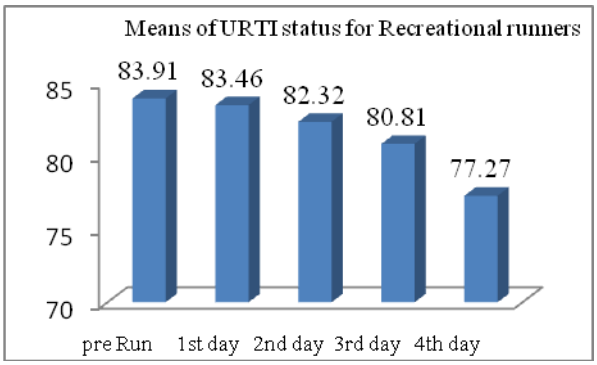

Table IX. *Tukey HSD Post Hoc Analysis. For Recreational FEV_1 Status (0.05 = 0.78)*

URTI Means	1st day 83.46	2nd day 82.32	3rd day 80.81	4th day 77.27
Pre run 83.913	0.447 N. Sig	1.593 Sig	3.1 Sig	6.64 Sig
1 day 83.46	-	1.146 Sig	2.65 Sig	6.19 Sig
2nd day 82.32	-	-	1.507 Sig	5.04 Sig
3rd day 80.81	-	-	-	3.54 Sig

Discussion

URTI symptom scores of professional runners and recreational runners of the study, Upper respiratory tract infections due to high intensity competitive marathon running. Recreational runners are more vigorous in the URTI symptom scores; hence, they are more aggressively prone for upper respiratory tract infections due to acute marathon competition running. There seems to be certain advantage for the regularly aerobically trained individuals, in counteracting to the immune-suppression due to better adaptation (Gleeson M.2006), less aggressive in bronchial inflammation due to URTIs. Loss of lung function correlated to decrements in FEV_1 was also observed in both professional and recreational runners of the study, but, recreational runners could not recover from the decrements in $FEV_{1,}$ whereas the professional runners seems to recover much earlier with respect to loss of FEV_1 and could gain form much sooner. Though it may not be possible to relate increments of URTI symptom score and loss in lung function through decrements in $FEV_{1,}$ the reason could be bronchial epithelial inflammation (Couto M, Silva D, et.al. 2013) and severe antigen challenge due to immune suppression (Bermon S. 2007) and possible loss in $FEV_{1.}$

Conclusions

Both professional and recreational runners are prone for URTI symptoms post their acute competitive marathon running, though the professional runners URTI symptoms are less vigorous when compared to recreational runners. Also, professional runners were able to recover from these symptoms much earlier and training shows advantage in tackling URTI symptoms due to ultra aerobic efforts of high intensity. With respect to FEV_1 also both professional and recreational runners experienced the same tendency of loss in FEV_1 post their acute marathon running event. Again the professional runners were able to regain the FEV_1 capacity quicker than the recreational runners of the study. Even the decrements in FEV_1 capacity is less among the professional runners, indicating adaptation to training.

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