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Acute effects of ultra-endurance running on the upper respiratory tract symptoms among the recreational women runners

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Abstract
Regular exercise in moderate intensities and for moderate durations has been very effective in promoting functional health and disease prevention capacity. However, in the recent past several motivated individuals are trying to involve in high intensity and very long duration aerobic dominant activities like marathon running, ultra-endurance cycling etc to enhance their health fitness and functional health. Though the general perception is that exercise is a positive tool in bringing positive changes in the health, the exercise seems a stressful activity which also promotes oxidative and inflammatory damages. Especially the high intensity and very long duration and sustained activities like marathon running may induce uncontrolled or excessive oxidative and inflammatory processes that might compromise the whole-body immunity and specially in acute conditions, the immediate effect may be on the respiratory tract physiology. Recreational runners who are taking up running as their favourite physical activity to promote health may not prepare adequately to tackle these negative pathological processes and may prone for frequent respiratory infections. It is more specifically important for the women recreational runners, as their immune suppression may be much aggressive due to these acute high intensity exercises like marathon training. It is important for the women recreational runners as most of them are aged, need to regularly monitor their upper respiratory tract health through credible quantification techniques and also should adopt excellent strategies of training and recovery like scientific physical training before the event and also the excellent nutritional strategies.

Keywords: Recreational runners, high intensity sustained exercise, oxidative stress, inflammation

Introduction
General perception about exercise effects: Exercise seems a very effective tool in terms of maintaining proper physical fitness and health fitness. The studies are indicating that the enhanced physical fitness in general could lead for the enhanced physiological fitness and enhanced health. Enhanced health status of the body may be attributed to various upgraded mechanisms like amplified immune efficiency both mucosal and cell mediated, increased metabolic pathways of preferential substrate utilisation, regularised circadian rhythms and many more. As a complex scenario, all these amplifications of the different metabolic cascades could lead for the enhanced disease resistance status among the individuals and hence the heightened health status. The exact mechanism through which the enhancements in physiological fitness occurs in the body has been a very debated issue and until recently there was no proper understanding on this.

The discovery of the exercise factors or the chemical substances released which undertaking the skeletal muscle contractions during the physical activity paved a new thought process and could identify the exercise effects more scientifically [18]. These chemical substances released by the skeletal muscles during the contraction were termed as myokines [1]. It seems that these myokines released during the muscle contractions while exercising could cross talk with several organs of the body simultaneously and could produce both pro-inflammatory and anti-inflammatory mechanisms that might contribute for a positive enhancement in the metabolic homeostasis.

There are several myokines which are released during the muscle contraction during the physical exercise may act as pro inflammatory cytokines and would initiate the anti-inflammatory cascades so that there would be heightened immunity in the body [9].

Exercise has always been recognised as a necessary inflammatory process that would attenuate the anti-inflammatory cascades in the whole body [10]. Interleukin-6, Interleukin-8, Interleukin-1ra, Irisin, PGC1α, Tumour Necrosis Factor ά, BDNF or Brain Derived Neurotrophic Factor are some of the important myokines that are produced during the muscle contraction of the skeletal muscles. Hence, exercise seems a very effective in terms of maintaining the healthy homeostasis in the body that would bring attenuated immune levels to resist the diseases including both the communicable and non communicable disease alike. Improved mucosal immunity would help the individuals to fight against the pathogens that would affect the respiratory and digestive tracts through the flow of the immune bodies like immunoglobulins like Immunoglobulin-A or IgA [27], Immunoglobulin-G (IgG) etc, lactoferrins etc [17]. Enhanced C cell mechanism and macrophage adaptations lead for the enhanced capacity of the system to fight against the pathogens internally [11]. The myokines produced during the exercise may cause for the several metabolic changes that would bring positive adaptations like browning of white adipose tissue, control of adipokines the hormones released by the adipose or fat tissue, production of several heat shock proteins in the myocardial tissue and several such mechanisms. Exercise myokines like Irisin and PGC1α could cause drastic changes in the metabolism of the fats thereby controlling the hyperlipidaemia and other such pathological conditions that might corroborate for the cardiac events. There are several such positive changes through the exercise may be mentioned.

Exercise as a modulatory mechanism on oxidative and inflammatory processes: While the general and accepted phenomenon of the exercise seems very positive, there may be several biological circumstances that might prompt for the deteriorated health status due to excessive inflammatory processes or mismatched anti and pro inflammatory processes because of the exercise, improper nutritional status among the exercising individuals that might cause for the imbalanced inflammatory processes and oxidative processes, exceedingly excessive oxidative processes due to the exercise etc could cause for the reduced immunity both acutely and chronically [8]. Though the exercise is in general considered as a physical phenomenon that would cause for the enhancements in the health status through the heightened immunity and other mechanisms, the same exercise may also be considered as a pro oxidative and pro inflammatory in some conditions. There are different forms of exercise, basically anaerobic exercise and aerobic exercise. This division may be basing on the metabolic pathway preference during the exercise conducted. In fact, there is no pure anaerobic exercise or aerobic exercise in strict metabolic terms. Since, any exercise done uses the combination of both the aerobic and anaerobic metabolic pathways to draw the energy through different forms of substrates. Apart from this basic metabolic difference dependent differentiation, exercises may be recognised as resistance training, short duration high intensity exercises, long duration sustained activities. As already indicated any physical exercise will utilise both the aerobic and anaerobic metabolic pathways in certain proportions. The general discriminatory aspect in this regard is the exercise intensity or the difficulty in conducting the physical exercise. As the intensity progresses the ratio of the aerobic metabolism decreases and the anaerobic metabolism increases. Keeping this generic scientific logic, long duration activities or sustained activities may be termed as aerobic activities as the preference of aerobic metabolism would be more than the anaerobic metabolism.

Aerobic or sustained endurance activities and oxidative and inflammatory effects: The empirical evidences in exercise medicine, exercise endocrinology and exercise immunology indicate that there are two processes that are essential for the enhanced immune function and functional health of the body. They are inflammatory stress and oxidative stress. In fact, these two processes are termed as the necessary evils for the enhanced anti-inflammatory and anti-oxidative capacities of the body, as these two processes would initiate the defence mechanism through which the organism is capable of making changes necessary to cope with these two stresses. Some of the scientific evidences of the exercise immunology indicate that long duration, sustained high intensity exercises could induce negative biological environment in the tissues that might result in excessive oxidative and/or inflammatory stress [19]. The reasons may be myriad, like the exercise intensity itself being the prominent one, the others to mention may be the nutritional insufficiency in terms of preparation for the proposed exercise, lack of proper rest and recovery post exercise and many more such factors.

Though medium intensity sustained aerobic activities could foster positive hormesis through which the organism may be able to recoup and recover well and, in the process, may equip the enhanced functional status to tackle the disease conditions. But the high intensity sustained aerobic activities like long distance and ultra-long distance running like marathon running, ultra-marathon running, long distance to very long-distance cycling, long distance swimming etc. In general, the competitive running certainly requires high intensity effort as the sportspersons would like to prevail up on the opponents and also target the record performances during the competitive events. Though intensity of exercise depends on the level of adaptation an individual already had with respect to the exercising capacity, the empirical evidences indicate that the competitive athletes and elite sportspersons may not be frequently prone for such oxidative and inflammatory stress during their training as well during their competitive efforts. But, some of the scientific studies also indicated that even the elite sportspersons could also be affected through the high to very high intensity aerobic training and competition and may experience negative effects of oxidative and inflammatory stress. This may even cause to reduced performances, injuries, reduced motivation and even the over training syndrome among the elite sportspersons. Injuries to elite sportspersons is so damaging that they would cause for the discontinuation of the training regimen and severe loss of form, especially in individual athletes.

Exercise induced respiratory inflammatory events and oxidative stress events: High intensity long duration sustained activities like marathon running could induce negative inflammatory events or inflammatory events that may be excessive and uncontrolled could cause for strain on the respiratory pathway physiology, like compromises in the integrity of the respiratory epithelial tissue causing damages to the epithelial layer of the respiratory tract and also

negatively influence the mucosal secretions of the bronchial tract due to hyperventilation and consequent excessive dehydration [4]. The loss of integrity of the epithelial layer of the bronchial tract could offer a window of infection from the pathogens like the viruses, bacteria etc. This condition may be more severe during the excessive intensity sustained long duration activities [20] or soon after the termination of the high intensity aerobic activities or some period post the high intensity sustained aerobic effort, which may in some cases go beyond ten days. A very important caution seems that the exercise effect of inflammation need not be looked independently, as the inflammation may be the result of many other factors that might contribute along with the high intensity aerobic exercise. Another mechanism that might be the results of the excessive inflammation may be the proteolysis effect of the hormones and enzymes or else the catabolic effect of inflammation that would resist the protein synthesis effectively, resulting in the reduction in the hormone, enzymes and immune proteins or else suppression of these protein substances [26], which are very effective immune proteins, which in fact act as first like defence against broad-spectrum viruses and bacteria, especially in the respiratory tract and the alimentary tract [12]. Higher and uncontrolled respiratory tract inflammation could also induce for the suppression of the mucosal immune proteins especially those which are present in salivary mucosal fluids like immunoglobulins etc and hence could cause for the reduced mucosal immunity especially in the upper respiratory tract areas leading to respiratory tract infections.

Another very significant mechanism that may pose threat to the functional health and immunity levels of the organism is oxidative strength. The general metabolic pathways indicate that the tissues generate lot of oxidants like super oxides, nitric oxides etc due to the substrate catabolism. These oxidants are highly active and could cause for severe cell membrane damages and also nuclear damages causing debilitating effects including the creation of pro cancerous conditions in the tissues. But, the endogenous production of the anti-oxidants is quite natural and innate to the human organism and will try to offset or neutralise the oxidants with the anti-oxidant mechanism [2]. In general conditions or in the non-exercising conditions individuals existing endogenous anti-oxidative strength or the organisms would be able to tackle the stressful effects of the oxidative stress. But exercise is considered as the higher oxidative stress and especially the oxidative stress during the high intensity long duration sustained like marathon running and ultra-endurance cycling [25] efforts seems very high and may mismatch the endogenous anti-oxidative strength of the sportspersons [21]. The sports nutrition experts are indicating and emphasizing the effect of nutrition on the sportspersons training and performance. In consonance with the epigenetics and nutrigenetics studies, the sports nutrition studies are indicating that enough anti-oxidants containing foods are to be consumed by the sportspersons in their daily routine to maintain and to protect the anti-oxidative strength that could offset the oxidative stress relating to the high intensity long duration practice sessions and also the competition efforts. Anti-oxidants containing foods are to be consumed on regular basis to avoid the oxidative stress negative effects [3]. There are several anti-oxidants which may be in the form of phenols and polyphenols which may be absorbed in its direct form and would cause impressive effects on the controlling of the oxidative stress mechanisms [22] and also could neutralise the excessively produced oxidants during the beta oxidation of the free fatty acids and other substrates.

Recreational running and women recreational runners and their functional health: There is a sudden spurt in the fitness activities due to the enhanced awareness among the people in general, and in particular the urban youth both men and women are taking part in the fitness activities. Running seems very preferred physical activity for many fitness enthusiasts to enhance and to protect their fitness and health. There are several women fitness enthusiasts taking to running as their form of physical activity and the numbers are increasing tremendously across the globe and especially among the urban working women. These runners in general are not well organised in their training for the running and many a time not on scientific lines, as these are mostly self-styled runners or else coached or trained by some other experienced self-styled coach runners. Keeping aside the scientific training aspect of these runners, these runners are generally forming in groups and prefer group training and group running which may be slightly unscientific as the individual differences in terms of the biological limits of exercise induced inflammation and exercise induced oxidative stress are highly different and variant due to various reasons and conditions [24]. Most of these runners both men and women runners, start their running careers very late in their life journey, mainly when they become self sufficient and be able to devote time and money for this activity and several of them were inactive during their growing ages.

These women runners do not aim to compete at the regular sports events, but would limit their participation to group runs or else to events like the city marathons and ultra-marathons, and hence they may be termed as the recreational runners and not competitive runners. These recreational women runners apart from being suddenly overactive with respect to their physical activities but also, they make themselves hypermotivated to progress to the higher order long distance running without any gestation or adaptation period. It is also important to note that the recreational women runners come from broad-spectrum financial backgrounds and age ranges. There are women recreational runners who are participating in marathon runs even at the age of eight and post their eighties and their scientific preparation to such high intensity sustained activities should be very high and strict [16]. The possibility of women runners, especially those who are in advanced age like fifty years and above and attempting to run the high intensity sustained marathon runs need to be more vigilant as their anti-inflammatory and anti-oxidative capacities may be less and could cause for severe compromises in the pathophysiology of the respiratory health of such women runners.

Considerations in understanding the respiratory health of the women recreation runners: There are no studies which indicate that there may be significant differences in terms of variable anti-inflammatory and anti-oxidative strength of women when compared to men, especially among the recreational runners [15]. As it is evident that the acute involvement in the high intensity sustained endurance running like marathon running could induce potential levels of oxidative and inflammatory stress among the recreational women runners, it would be always ideal to monitor the respiratory health of these women recreational runners [7]. Those who are highly adapted for these types of endurance running may not experience much physiological stress and may not get affected. Some scientific studies in exercise

immunology indicate that the recreational runners in general are prone for frequent respiratory tract infections and specially the upper respiratory tract due to the acute inflammatory and oxidate stress they undergo, due to the unaccustomed acute high intensity long duration runs and competitions. Uncontrolled and frequent respiratory tract infections could induce severe problems and could lead to bigger respiratory problems [6]. Since, it is not possible to quantify the anti-inflammatory and anti-oxidative strength of the individuals and especially the recreational runners, some of the researchers attempted to quantify the respiratory tract infection levels through the well adapted questionnaires. One such questionnaire that could quantify the upper respiratory tract infection status through the quantification of the possible symptoms of such infections, is Wisconsin Upper Respiratory Symptom Survey– 44 (WURSS-44). This questionnaire 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, and is considered as very scientific and credible by scientific community to measure the upper respiratory tract infection status. A total of thirty-two symptoms were identified and were incorporated in this questionnaire with zero to seven scale options to quantify the symptoms in total. It would be better to measure the URTI symptom status among the recreational women runners more frequently, or at least before and after acute attempt of ultra-endurance running like marathon running. Sometimes, some of the recreational runners or regular sportspersons may not show significant changes in their URTI symptom score, but may experience some breathing problems during their exercise training or during their competition efforts [5]. Sometimes, it may happen though the respiratory tract been with inflammation or with slight infection, may reflect in their lung function and thereby affects their performances or may even lead for chronic lung problems if not attended properly and in time. Hence, it would also be ideal to monitor the lung volumes which may always be correlated by the medical community with the lung health in general [13]. The spirometry techniques are used to measure some of the lung function variables. The digital spirometry has revolutionised the measurement of the pulmonary function variables and now are very reliable and credible to understand the lung function and lung health status [23]. Some of the very important pulmonary function variables that would reflect the lung health of the individuals are FEV (Forced Expiratory Volume), FEV_1 (Forced Expiratory Volume in the first second of the effort), FEV_1/FVC ratio (ratio between the Forced Expiratory Volume in the first second and the Forced Vital Capacity). Studies are indicating that the lung values of the individuals may reflect the lung health of the individual and hence the recreational runners may be required to regularly monitor both their respiratory infection status through the symptoms and also through the measurement of respiratory capacities at regular intervals to avoid serious lung infections [14].

Conclusion and recommendation

Recreational women runners, those who are engaging in acute type of high intensity long duration runs like marathon and half marathon running, need to be very cautious with respect to their anti-inflammatory and anti-oxidative strengths. They need to protect themselves with sufficient adaptation in training and proper nutrition and other strategies to avoid unnecessary respiratory complications as the acute high intensity long duration physical activities may cause for loss in integration of the bronchial tissue leading to respiratory tract infections.

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