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To study respiratory exchange ratio with academic stress and physical activity levels in first year MBBS students

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Abstract
Introduction: Academic stress may cause the changes in the physical and mental activity of students so that aim of the present study was to correlate effect of academic stress and Physical Activity with Respiratory exchange ratio. and creating awareness about physical activity and life style modification for primary prevention of cardiovascular and metabolic and mental disorders.
Methodology: This observational study conducted in Department of Physiology, RUHS College of Medical Sciences after taking approval from the ethical committee. A total 70 subjects screened out of 40 subject had stress score greater than 20 were included, aged 18-25 years both sexes male and female included. Data collection procedure & instrument used were Medical Stress Scale, Global physical activity questionnaire**,** Resting exchange ratio assessed.
Results: The BMI was positively correlated with RER and stress score and negatively correlated with physical activity and RER negatively correlated with physical activity and positively correlated with stress score physical activity negatively correlated with stress score.
Conclusion: The utility of physical activity used as a one of strategy for coping or stress management and prevention of activation of various inflammatory pathways leading to development of various cardiovascular, metabolic and mental disorders.

Keywords: stress, physical activity, RER

1. Introduction

Stress in medical education is common and process-oriented this lead to a negative effect on academic performance, physical and mental health, and psychological wellbeing [1].
Stress may be defined as a state of threatened homeostasis, which is counteracted by adaptive processes involving affective, physiological, biochemical, and cognitive–behavioral responses in an attempt to regain homeostasis [2, 3]. "Stress used to describe experiences that are challenging emotionally and physiologically'' [4]. Stressors further classified in acute (e.g., hassles) or chronic (e.g., bereavement), small in magnitude (e.g., standing in a long line), or traumatic (e.g., violent attack) [5]. One of the most notable stressors in students' lives is academic stress [6]. The effectiveness of academic stress as a psychosocial stressor is well accepted regarding consequence on physiological and psychological health [7]. Medical school training requirements can be stressful to medical students [8]. There is a growing concern about stress, depression and anxiety in medical students and its effect maximum on graduate output [9]. Depression is described as more prevalent in medical students than in the general population [10]. During Academic stress, different effects on psychological parameters i.e increased anxiety, poor sleep quality, a negative effect on well-being, increased negativity and prevalence of depressive symptoms [11, 12]. Based on these findings, it can be assumed that high academic stress have a negative impact on health-related physiological and psychological outcomes. Many factors contribute to medical college life a very stressful environment. Some of them are: Vastness of academic curriculum, Lack of special guidance from faculty, Inadequate clinical material, Difficulty in reading vast medical books, frequency of examinations, emotional problems, financial problems, conflicts with colleagues and seniors [13, 14]. Stress may have a direct effect on health i.e alterations in the immune system, dysregulation of hormonal axis, indirect routes toward maladaptation [15, 16]. Stress has been strongly implicated in the pathogenesis of coronary heart disease, cardiac events and increased incidence of myocardial infarctions. [17, 18]. Stress is represented with a host of mental symptoms, including cognitive dysfunction, dementia, anxiety and fatigue [19, 20].
The adaptive capacity to deal with stress is physical fitness [21]. Physical Activity defined as "any bodily movement produced by skeletal muscles that results in energy expenditure above resting (basal) levels [21, 22]. Physical activity broadly encompasses exercise, sports, and physical activities done as part of daily living, occupation, leisure, and active transportation" [24]. The association between physical activity, exercise, and health outcomes is well-known [25, 26]. Intervention studies suggested that increased physical activity results in profound reductions in physical and mental disorders. [27, 28]. Pederson proposed the "diseasome of physical inactivity" hypothesis which states that the visceral fat accumulation due to physical inactivity causes activation of various inflammatory pathways leading to macrophage infiltration of visceral fats leads to chronic systemic inflammation leads to insulin resistance, atherosclerosis, neurodegenration, development of various cardiovascular and metabolic disorders [29]. There is a similar picture for physical activity on mental health outcomes. Those who exercise suffer from less depression, anxiety, fatigue, and cognitive impairments [30]. Three broad

potential mechanisms that connect physical activity to mental health i.e neurobiological, psychosocial, and behavioral. neurobiological mechanisms responsible for cognitive functioning, involving changes in the central cells, molecules, and circuits biomarkers (eg, gray matter volume, cerebral blood volume, flow and peripheral biomarkers circulating growth factors, inflammatory markers. psychosocial mechanism hypothesis recognizes that physical activity provides an opportunity for social interaction, self-efficacy and perceived competence, behavioral mechanism hypothesis participation in physical activity may improve sleep duration, sleep efficiency, sleep onset latency, reduce sleepiness and self-regulation and coping skills that have subsequent implications for mental health [31].

The Respiratory Exchange Ratio (RER) is the ratio of CO2 production/O2 uptake, increase with the exercise intensity and measured under steady state conditions is commonly used to indirectly determine the relative contribution of carbohydrate and lipids to overall energy expenditure [32].A high RER indicates that carbohydrates are being predominantly used, whereas a low RER suggests lipid oxidation [33]. Sedentary lifestyle increases the RER values, but decreases the insulin sensitivity, muscle oxidative capacity and contributes to decrease whole body fat oxidation [34, 35]. On the contrary, physically active and trained subjects exhibit lower RER than untrained subjects in response to comparable workloads [36]. In literature very few studies [37, 38]. available on RER and no article has attempted to synthesize this type of study which correlate academic stresss, physical activity with RER in medical students. Thus academic stress may cause the changes in the physical and mental activity of students so that aim of the present study was to correlate effect of academic stress and Physical Activity with Respiratory exchange ratio. and creating awareness about physical activity and life style modification for primary prevention of cardiovascular and metabolic and mental disorders it was well known fact that physical inactivity causes activation of various inflammatory pathways leading to development of various cardiovascular and metabolic disorders.

Methodology

This observational study conducted in Department of Physiology, RUHS College of Medical Sciences after taking approval from the ethical committee(EC/04).A total 70 subjects screened out of 40 subject had stress score greater than 20 were included, aged 18-25 years both sexes male and female included,those willing to given written informed consent. The excluded ones were those who had history of any Cardiovascular, Pulmonary, Neurological disease, Musculoskeleton disorders, Any abnormality detected during the physical examination that might have adversely affected the participant's health, Subjects Consuming sedative and antidepressants medicines. Smokers and alcoholic, Tobacco chewers subjects will be excluded.

Data collection procedure & instrument used-

- **Medical Student Stressor Questionnaire (MSSQ):** The MSSQ was developed to identify the stressors of medical students as well as measure the intensity of stress caused by the stressors. The six domains of stress measured by the MSSQ. All the items were designed based on its suitability and compatibility with the local cultures and values. The SSQ grouped stressors into six domains, each based on a common underlying theme: 1. Academic related stressors (ARS) 2. Intrapersonal and interpersonal related stressors (IRS) 3. Teaching and learning-related stressors (TLRS) 4. Social related stressors (SRS) 5. Drive and desire related stressors (DRS) 6. Group activities related stressors (GARS) Score values:0.00 – 1.00 = Mild, 1.01 – 2.00 = Moderate, 2.01 – 3.00 = High & 3.01 – 4.00 = Severe [37].
- **Global physical activity questionnaire (GPAQ):** for assessment of physical activity level (PAL): This questionnaire collects information on physical activity participation in three settings (domains): activity at work (work or occupational physical activity), travel to and from places (active travel), and on leisure time physical activity (recreational physical activity), as well as sedentary behavior. The amount spent doing physical activity was quantified using Metabolic Equivalent of Task(MET), which is the ratio of person's working metabolic rate to the resting metabolic rate. Low levels of physical activity will be defined as <600 MET minutes per week and high levels of physical activity will be defined as >3000 MET minutes per week. Low levels of physical activity (<600 MET minutes per week) will be considered as insufficient physical activity [38].
- **Respiratory exchange ratio:** assessed by indirect calorimetry (ADI Gas analyzer : model-ML206) in healthy young adults. RER will be measured by standard protocol mentioned below. The treadmill GXT protocol required participants to walk at a brisk pace at level grade for 3 min, followed by jogging at a self-selected speed at level grade (4.3-7.5mph) 6.9-12.06 km/hr for an additional 3 min. Thereafter, the treadmill grade is increased 2.5% every min (treadmill speed remaining constant), until participants achieved volitional fatigue [39, 40]. The subject was asked to come in the morning time after an overnight fasting. The subject should not have performed any form of exercise before the test. Then test protocol was explained to the subject and demonstrated the same.

Statistical analysis

Done by spss software 20. Multiple regression analysis will be used to see the statistically significant relationship between physical activity level, stress and cognitive functions.

Results

A total forty subject divided into 26 male and 14 females, mean age was 19.94 ±2.12 years. Table 1 showed age and gender distribution of male and females.

Table 1: Age and Gender distribution of the Study population

Age group	Male	Female	Total
18-25 years	26	14	40
percentage	65	35	100

Table 2: Body Mass Index, Respiratory Exchange Ratio, Global Physical Activity Questionnarie score and Stress Score in Male and Female

Parameters	Male (n=26)	Female (n=14)	p value
	Mean ± SD	Mean ± SD	
Age	19.65 ± 1.77	19.57 ± 2.14	0.8966
Bmi	22.54 ±3.97	23.14 ±3.53	0.6364
Rer (rest)	.89±.06	.92 ±.04	0.2174
Rer (exertion)	.97 ±.08	1.01 ±.08	0.1342
Gpaq	1595.38 ±1159.70	1188.57±551.90	0.2248
Stress score	3.15 ±1.38	3.95±2.74	0.0374

P value <.05(significant)

(BMI- Body mass index, RER –Respiratory exchange ratio, GPAQ- Global physical activity questionnaire) Table 2 showed the data of 40 medical subjects of both sexes. Results shows that mean BMI, RER in resting and exertion and GPAQ score were nonsignificant in male and female and stress score was higher in femaleand highly significant.

Table 3: Correlation of BMI, Resting RER, Exertional RER with GPAQ and stress score

		Rer(Rest)	Rer(Exertion)	GPAQ	Stress Level
BMI	r	0.5380	0.2160	-0.2789	0.2257
	p Value	0.0003	0.00808	0.0513	0.1614
	Inference	HS	NS	S	NS
Rer(Rest)	r		0.4830	-0.1068	0.1529
	p Value		0.0016	0.5120	0.3463
	Inference		VS	NS	NS
Rer(Exertion)	r			-0.5500	0.5820
	p Value			0.0002	0.0001
	Inference			HS	HS
GPAQ	r				-0.8210
	p Value				<0.0001
	Inference				HS

Table 3 depicts the correlation of BMI, RER (in rest and exertion), GPAQ score Stress score in medical subjects. The BMI was positively and significantly correlated with RER (resting and exertion), stress score (NS) and RER(exertion) negatively correlated with physical activity levels and positively with stress levels and physical activity negatively and statistically significantly correlated with stress levels.

Discussion

Medical school is recognized as a stressful environment that often exerts negative effect on the academic performance, physical health and psychological well-being of the students. There is a growing concern about stress and depression in medical students and its effect proper and optimal graduate output. In this study an attempt to correlate effect of academic stress and physical activity with respiratory exchange ratio and creating awareness about physical activity and life style modification for primary prevention of cardiovascular and metabolic and mental disorders,physical inactivity causes activation of various inflammatory pathways leading to development of various cardiovascular and metabolic disorders.

RER use as a physical fitness indicator used under submaximal exercise tests in this study which was similar with study done by Achten *et al* [41], Billat *et al* [42]. In this study RER was negatively correlated with physical activity levels which depicts if physical activity increased RER value decreased which was similar with study done by Messonnier *et al* [43], Bergman *et al* [44].

In this present study decreased RER values after physical exercise possible mechanism was increasesd the activity of some mitochondrial enzymes, like citrate synthase, cytochrome C oxidase and β-hydroxyacyl-CoA dehydrogenase such biochemical changes drive fatty acid oxidation, which was similar with study done by Tonkonogi *et al* [45], Short *et al*. [46], Menshikova *et al* [47].

In this present study finding showed that if physical activity level inversely related to stress level which showed that physical activity intervention effect on mental health outcomes similar with study done by Lindegard *et al* [48], Rethorst *et al* [49].

In this study finding suggested physical activity level negatively correlated with stress levels and results were highly significant which depicts if physical activity increased stress level decreased results were similar with study done by Hillman *et al* [49]. who reported after physical activity neuroelectric index of attention,processing speed, attentional inhibition,response accuracy increased and stress score decreased.

Krafft *et al* [50]. correlated that after physical activity stress level decreased, enhanced cognitive function composite,planning, attention global executive function and response accuracy increased similar with results of present study.

Conclusion: In this study physical activity and Respiratory exchange ratio negatively correlated with stress level that represent that stress impedes individuals' efforts to be more physically active, just as it negatively influences physical and mental outcomes.. The utility of physical activity used as a one of strategy for coping or stress management and prevention of activation of various inflammatory pathways leading to development of various cardiovascular, metabolic and mental disorders.

Limtations

Future empirical research in larger sample and more

research looking for associations of RER with other fitness indicators and heath parameters in populations.

Footnote
We thanks Faculty of department of physiology and all the subjects who so willingly took part in this study

Conflicts of interest
None

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