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The Impact of Physical Activity Status and Dietary Habits on the Lipid Profile and Atherogenic Index of Plasma

[1]Asim Alaaeldin Osman, [2]Salah Eldeen Dafalla and [3]Ahmed Doleib Ahmed
[1]*Department of Human Physiology, Faculty of Medicine and Health Sciences, University of Gadarif, Sudan*
[1]*Department of Physiology, Faculty of Medicine, University of Sciences and Technology, Omdurman, Sudan*
[2]*Ibn Sina National Collage for Medical Studies, Saudia Arabia*
[3]*Hayaat University Collage, Khartoum, Sudan*

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Corresponding Author:
Asim Alaaeldin Osman
Department of Human Physiology, Faculty of Medicine and Health Sciences, University of Gadarif, Sudan

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Abstract: Regular Physical Activity (PA) induces desirable changes in plasma lipid level that reduces the risk for cardio-metabolic disorders. On the other hand, physical inactivity and bad nutritional habits had multiple bad health impacts. The aim of this study was to examine the effect of physical activity, physical inactivity and nutritional habits on the lipid profile and Atherogenic Index of Plasma (AIP). In this cross sectional study, a sample of 207 healthy medical students (100 males and 107 females) were recruited. Lipid profile measured by spectrophotometer. Arab Teens Lifestyle (ATLS) questionnaire was used for assessment of physical activity status and dietary habits. The results revealed that Low Density Lipoprotein (LDL) was significantly higher in males than females. Triglyceride (TG) was significantly negatively correlated with the frequency of stair climbing. TG was significant positively correlated with sleeping hours. High TG was associated with increase fruits intake. Total Cholesterol (TC) was significantly negatively correlated with the time spending in dancing in female. atherogenic index of plasma was significantly higher in males and significantly higher in inactive participants. Based on the results, it is concluded that moderate intensity physical activity decrease the total cholesterol and triglyceride while increase sleeping hours increase triglyceride. Therefore, increasing the physical activity intensity and decreasing physical inactivity time should be used as preventive measure for cardiovascular diseases.

INTRODUCTION

Regular Physical Activity (PA) for young people provides an immediate and long-term physical and psychological well-being. In contrast physical inactivity regarding as risk factor for mortality, accounting for around 6% of deaths globally (World Health Organization, 2010). The benefits of regular PA have been clearly set out across the lifespan. For adults, engaging in 30 min of moderate intensity PA at least 5 days a week helps to prevent and manage over 20 chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity and musculoskeletal disorders (World Health Organization,

2010). Physical inactivity and unhealthy diets regarded as major risk factors for most non-communicable diseases (World Health Organization, 2002). In addition, research findings regarding physical inactivity showed that TV watching independently associated with cardio-metabolic risk factors [3]. Regular PA induces desirable changes in plasma lipid levels (Halverstadt *et al*., 2007) such as increase of HDL and decrease of TG as well as decreasing TC, low-density and very-low-density lipoproteins (Kraus *et al*., 2002; de Munter *et al*., 2011).

Atherogenic Index of Plasma (AIP) is a novel index composed of triglycerides and high-density lipoprotein cholesterol (Dobiasova *et al*., 2001). It has been commonly used as optimal indicator of dyslipidemia and cardiovascular diseases (Bora *et al*., 2017; Yang *et al*., 2017). AIP has been proved to be significantly correlated with other important atherosclerosis indexes such as LDL size and small-dense LDL (Kucera *et al*., 2014; Ivanova *et al*., 2017). Therefore, aim of the present study was to access the effect of physical activity, sedentary behaviour and dietary habits on lipid profile and atherogenic index of plasma.

MATERIALS AND METHODS

Subjects: Cross-sectional study was conducted in 207 Sudanese medical students (100 males and 107 females) aged 18-22 years. Each participant is given an informed consent before being invited to take part in the study. Ethical approval was issued from the ethics committee of international university of Africa, Sudan.

Assessment of physical activity, physical inactivity and dietary habits: A validated self-reported Arab Teen Life Style (ATLS) questionnaire was used this questionnaire designed to collect complete information regarding physical activity, physical inactivity and eating habits.

Regarding the level of physical activity of participants the questionnaire collects information about frequency, duration and intensity of a variety of light, moderate and vigorous-intensity physical activities during a typical week. Physical activities were assigned as Metabolic Equivalent (MET) values according to the compendium of physical activity.

Regarding physical inactivity and sedentary behaviours questions included the time spent on Television (TV), video and computer games as well as internet using. Participants were asked to provide the average number of daily hours spent in such activity March 28, 2020without differentiating between weekdays and weekends. For the total screen time cut-off points, we used the American Academy of Paediatrics guidelines of a maximum of 2 h per day for sedentary behaviours.

Regarding assessment of eating habits ATLS questionnaire also included some questions that asked about how many times per a typical week the participants consumed breakfast, sugar-sweetened drinks, fast foods and energy drinks. These questions covered healthy and unhealthy dietary habits. The students had to choice from zero intakes to a maximum intake of 7 days per week (every day).

Assessment of lipid profile and AIP: About 5 mL of fasting blood samples were collected and analyzed by spectrophotometer by standard methods to assess plasma TC, TG, HDL and LDL levels. AIP calculated as $\log_{10}$ (TG/HDL).

Statistical analysis: For base line data descriptive analyses was used, to compare between the means of different variables independent t-test was performed. Personal correlation was performed to assess the correlation between different variables. Data was presented as mean±SD, $p<0.05$ was considered statistically significant. All statistical analyses were performed with PASW for Windows® Version 24.0 software (formerly SPSS statistics Inc. Chicago, Illinois).

RESULTS AND DISCUSSION

In our study population female is slightly more than male. Weight and height were significantly higher in males. Males were significantly more active than females. LDL and AIP were significantly higher in males than females (Table 1).

Regarding physical activity level only 28.5% of the participants were regarded as active while 71.5% were inactive.

Table 1: Comparison of anthropometric measure, lipid profile, AIP and total physical activity expressed as sum of MET between males and females

Variables	Males (n = 100) Mean±SD	Females (n = 107) Mean±SD	p-values
Age (years)	19.50±1.580	19.07±1.1	0.020
Weight (kg)	67.04±13.875	60.57±13.239	0.001
Height (cm)	1.7159±0.6425	1.5875±0.05740	0.000
BMI	22.8817±5.16791	24.0607±5.30677	0.107
TC (mg dL^{-1})	151.67±32.15	145.59±32.18	0.170
TG (mg dL^{-1})	100.25±31.99	97.88±30.98	0.560
LDL (mg dL^{-1})	97.04±31.36	87.92±32.77	0.040
HDL (mg dL^{-1})	34.58±16.99	30.1±20.44	0.180
AIP	0.49±0.024	0.43±0.27	0.003
Sum of METs	1775.08±1841.6	1158.27±1272.89	0.005

March 28, 2020

Table 2: Correlation of lipid profile and AIP with the different types of regular physical activities/week

Physical activity pattern	TC	TG	LDL	HDL	AIP
Stair jumping					
Person correlation		-0.159*		-0.175*	0.164*
Sig. (2-tailed)		0.022		0.012	0.018
Dancing					
Person correlation	-0.147*		-0.153*		
Sig. (2-tailed)	0.03		0.028		
Body build sports					
Person correlation					0.213**
Sig. (2-tailed)					0.002
High intensity activity					
Person correlation					0.237**
Sig. (2-tailed)					0.001

Table 3: Correlation of TG with the sleeping hours per week

Variable	Sleeping hours per week
TG	
Person correlation	0.154*
Sig. (2-tailed)	0.027

*, **Values are significant

Table 4: Comparison of dietary habits between males and females

Variables	Males (n = 100) Mean+SD	Females (n = 107) Mean+SD	p-values
Breakfast intake	1.97±1.77	1.75±1.45	0.323
Sugary drinks	4.54±2.16	4.57±2.34	0.924
Vegetables intake	3.94±2.42	3.80±2.28	0.680
Fresh fruits intake	2.60±2.10	2.46±2.18	0.63
Dairy milk products intake	4.49±2.54	3.79±2.55	0.050
Fast food (pizza, hotdog, burger) intake	3.81±2.25	4.79±2.02	0.001
French fries/potato chips intake	1.71±1.91	2.67±1.94	0.000
Cake, donuts and biscuits intake	1.82±2.29	3.40±2.41	0.000
Sweet/chocolate intake	1.92±1.88	2.91±2.15	0.001
Energy drinks intake	0.59±1.44	0.31±1.28	0.138

Table 5: Correlation of TG and AIP with the fruits and dairy products intake per week

Variables	Frequency of fresh fruits intake per week	Frequency of dairy products intake per week
TG		
Person correlation	0.196**	-
Sig. (2-tailed)	0.005	-
AIP		
Person correlation		0.155*
Sig. (2-tailed)		0.025

The correlation between performing regular physical activity per week with the lipid profile and AIP revealed that TC and LDL significantly negatively correlated with dancing, TG significantly negatively correlated with stair climbing while AIP significantly positively correlated with stair climbing, high intensity activity and body build sports (Table 2).

On the other hand, sleeping duration is the only type of sedentary behaviour patterns that significantly positively correlated with TG (Table 3).

Regarding the dietary habits, females had significantly higher consumption of fast food, potato chips, cakes/doughnuts and sweets than males while male taking more dairy milk products than females (Table 4).

Results presented in Table 5 revealed that significant positive correlation between TG and AIP with the fruits and dairy products intake per week.

The present study was carried out to assess the impact of PA, physical inactivity and dietary habits on TC, TG, HDL, LDL levels and AIP. Previous study indicated that increase physical activity reduces the plasma lipids (Kannan *et al*., 2014), moreover regular exercise in early age contributes in reduction of the prevalence of obesity and consequently the risk of cardio-metabolic diseases (Lippi *et al*., 2006). In the present study, females were inactive than males, this consistence with previous study (Duncan *et al*., 2014). In addition, our results indicated that male were involved regularly in high intensity activities (soccer, basketball, swimming, etc.), weight lifting and to less extent in defence sports while the females were involved mostly in low or moderate intensives activity (walk, stair climbing, jogging) and household activities.

In the current study we assessed the impact of PA pattern and frequency on TC, HDL, LDL and TG levels, regarding the type of PA, TC and LDL significantly negatively correlated with dancing which was carried out only by females, so that, encouraging the females for regular involvement in dancing dependent exercise is of

advantage for prevention of lipid associated risk factors such as CVD. Furthermore, TG significantly negatively correlated with stair climbing, this result in accordance with the study that reported physical training leading to reduction in TG more frequently than reduction that might occur in TC or LDL levels (Durstine *et al*., 2002).

Regarding physical inactivity, the present study proved that total sleeping time was significantly positively correlated with TG. In contrast to our findings, among European adolescents, short sleep duration was shown to be associated with higher adiposity markers (Garaulet *et al*., 2011).

Regarding dietary habits, our finding revealed that females had significantly higher consumption of fast food, potato chips, cakes/doughnuts and sweets than males. This in consistence with the study that reported food consumption patterns had changed dramatically, since, the past four decades and the fat rich diet, sweet and sugar drinks are becoming in great demand among children and adolescents (Tayyem *et al*., 2014).

In the current study, TG significantly positively associated with the frequency of intake of fruits per week, this explained by fact that most of our responders taking fruits in form of juices that prepared by addition of large amount of sugar.

In contrast, a study among Omani adolescents showed that the consumption of fruits and vegetables was good among both genders (Kilani *et al*., 2013). Research conducted. In French adolescents reported that physical activity positively correlated with the consumption of fruit and vegetables (Platat *et al*., 2006). In addition, Kremers *et al*. (2004) showed that a low frequency of fruit consumption was associated with lowphysical activity among Dutch adolescents (Kremers *et al*., 2004). Furthermore, our finding showed that, AIP significantly positively associated with the frequency of intake of dairy products per week, this might be due to high consumption of full cream milk in Sudan.

CONCLUSION

This study confirms that regular physical activity, reducing sedentary time and decreased the intake of sugar and full cream milk would improve the lipid profile that prevent the development of cardio-metabolic diseases in adolescents and young adult.

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