



## **Comparison of Metabolic Syndrome, Uric Acid and Leisure Time Physical Activity between Former Athletes and Non-Athletes**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors were instrumental in the conception, research development and study design. Both authors read and gave final approval for the manuscript submission and publication.*

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### **ABSTRACT**

This study aims to determine the prevalence of metabolic syndrome (MS), overweight and obesity, uric acid (UA), and leisure time physical activity (LTPA) among former athletes and non-athletes in the Kingdom of Saudi Arabia (KSA). Moreover, to determine the effects of previous high intensity training on MS risk factors, overweight and obesity, and UA. Seventy-five (75) former athletes and twenty-six (26) non-athletes, aged between 26 and 60 years old, participated in this study. Height, weight, waist circumference (WC), blood pressure (BP), and blood samples were collected by the researcher. LTPA was reported by participants. The study results showed that 38.61% of former athletes have MS and 17.82% of non-athletes have MS. The study also showed that 31.68% of former athletes were overweight and 26.73% were obese. However, the prevalence of overweight and obesity among non-athletes was 9.90%. 23.76% of former athletes had high level of UA, whereas 14.85% of non-athletes had high level of UA. According to the study findings 28% former athletes participated in high physical activity (PA), 38.67% in moderate PA, and 33.33% in low PA,

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while 19.23% of non-athletes participated in high PA, 38.46% in moderate PA, and 42.31% in low PA. Former athletes had lower mean of body mass index, WC, fasting blood glucose (FBG), diastolic blood pressure (DBP), and UA than non-athletes. In addition, higher mean of low high-density lipoprotein (HDL). However, former athletes had higher mean of systolic blood pressure (SBP) and triglycerides (TG) than non-athletes.

*Keywords: Former athletes; metabolic syndrome; body mass index; diabetes.*

## 1. INTRODUCTION

Participating in high intensity exercise and training during young age is associated with several positive effects on health in later life, such as lowering the risk of cardiovascular disease (CVD) and type 2 diabetes (T2D) and decreasing the risk of early death [1–4]. The underlying explanations are various, however genetic predisposition, maintaining a healthy lifestyle and engaging in regular physical activity (PA) are significant factors [3-5].

The prevalence of non-communicable diseases is increasing rapidly. According to the World Health Organisation (WHO), by 2020 it is predicted that non-communicable diseases will account for 80% of the global burden of diseases, causing 7 out of every 10 deaths in developing countries, around 50% of them early deaths under 70 years old [5,6]. Moreover, it has been reported that about 20-25% of adults in the world have metabolic syndrome (MS) [7]. MS, overweight and obesity, and uric acid (UA) are nowadays a serious public health problem worldwide [1,2,5,8,9]. High Body Mass Index (BMI) is a major risk factor for coronary heart disease, T2D, hypertension, and increases the risk of early death [1,3,9]. Likewise, high level of UA has been associated with increased risk of CVD, T2D, hypertension, dyslipidaemia, and MS [8].

MS, elevated BMI, and high level of UA are serious public health issues and should be addressed through educational and prevention programmes. Management of those diseases includes changes in lifestyle with healthy eating habits, maintaining optimal body weight, and participating in regular PA [5,9].

The significance of regular PA and its favourable effects on decreasing the prevalence of CVD, obesity, and T2D is well recognised. Participation in PA and exercise in early stage of life can decrease the risk factors of several non-communicable diseases such as obesity, hypertension, glucose intolerance, triglycerides,

insulin resistance, and body fat [1–3,9]. Furthermore, engaging in regular PA can increase the level of high density lipoprotein (HDL), lean body mass, and basal metabolism [9].

Several studies have reported that many top athletes are engaging in sedentary lifestyle after stopping to participate in sport, which can cause a risk to their health [1,2,9]. However, the long term effect of high intensity exercise and training on MS, overweight, and obesity among former athletes have not been well studied except for some in Western Countries [3,4,10–17]. Additionally, we could not find any previous research that determine the influence of previous high intensity exercise and training on UA among former athletes. The study hypothesized that former athletes who participated in vigorous training or exercise had lower risk of MS risk factors, BMI, and UA. Therefore, this study sought to determine the prevalence of MS, overweight and obesity, UA, and LTPA among former athletes and non-athletes in KSA. Moreover, to determine the effects of previous high intensity training on MS risk factors, overweight and obesity, and UA in a cohort of former athletes in the kingdom of Saudi Arabia (KSA).

## 2. METHODS

A detailed description of the study design and participants has been published previously [5]. Briefly, to achieve the aim of the study, an online consent form was administered to participants. The link to the consent was sent to the Saudi Athletics Federation to ask them to send a request to former athletes to participate in this research. This study is limited to Saudi former athletes. Data were collected over a period of three months from January to March 2020. A total of 101 individuals agreed to participate, 75 former athletes and 26 non-athletes. The former athletes were male who had previously played in national and international competitions. The inclusion criterion was an age range from 20 to 60 years. Obtained data were recorded on a data

collection sheet developed by the researcher. The data sheet was designed to collect demographic characteristics of the former athletes, such as age, weight, height, BMI, waist circumference (WC), results of lipid profile, BP and fasting blood glucose level.

Anthropometric measurements, including weight, height, and WC, were obtained. Height was measured without footwear on using a measuring high rod with platform stadiometer to an accuracy of 0.1 cm. Body weight and body composition were determined at the same time by a bio-impedance body composition device (Omron BF511), with body weight to an accuracy of 0.1 kg. WC was measured midway between the anterior superior iliac spine and lower edge of the rib cage in a relaxed standing posture by using meter health tape. For the comparisons between our groups and data from the WHO, overweight was defined as a BMI 25–29.9, and obesity was defined as a BMI  $\geq 30$  kg/m<sup>2</sup>(1).

BP was measured using a standardised BP protocol based on the guidelines provided by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (2004) [18]. BP was measured using a validated digital automatic BP monitor (Omron Healthcare, model HEM-7322, Vietnam). After 5 minutes of rest, the researcher measured BP from the participant's left arm while he was sitting in a relaxed position. BP was assessed twice, and in between the assessments, there was at least a one-minute gap. The mean of two BP values was recorded. For assessing LTPA, the short form of the International Physical Activity Questionnaire (IPAQ) was used in this study.

For laboratory analysis and all biochemical measurements, early in the morning high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), triglycerides (TG), and fasting blood glucose (FBG) were taken by the researcher after an overnight fast of 10–12 hours through capillary finger stick. The LipiDiag 4 in 1 optics blood lipid analyser total cholesterol (TC), HDL, and TG cholesterol and the Benecheck 3 in 1 cholesterol and UA and glucose meter household portable analyser (model no. BK6- 12M&1. Taiwan) were used to analyse cholesterol and glucose. The meters were set as instructed using the code numbers on the test strip bottle. The test was performed using blood from the finger of the participants on the spot. Through the measurement, a test strip was inserted to turn on the meter. The test strip

was lined up with the edge of a blood drop from the participants to allow the blood drop to be drawn into the narrow channel of the test strip. Cholesterol, blood glucose, and UA level displayed were then recorded. The blood sample was obtained in accordance with the WHO guidelines on drawing blood [19].

We defined MS using the Third Report of the National Cholesterol Education Program (NCEP) Expert's Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). The current ATP III criteria identifies MS when there are at least three of the following characteristics: 'abdominal obesity, defined as a waist circumference >102 cm in men and >88 cm in women; serum triglycerides,  $\geq 150$  mg/dL; serum HDL cholesterol, <40 mg/dL in men and <50 mg/dL in women; blood pressure (BP),  $\geq 130/85$  mm Hg; and FBG,  $\geq 100$  mg/dL'[2]. Participants with UA levels > 7 mg/dL were considered as having high UA in this study [8].

## 2.1 Statistical Analysis

Continuous data are reported as mean  $\pm$  standard deviations, and categorical variables as frequencies and number (percentage). Comparative analysis involving two variables was performed using an independent sample t-test, while analyses involving more than two variables used tests with one-way ANOVA. Statistical analysis was performed using SPSS software version 23. The p-values <0.05 were considered to be statistically significant.

## 3. RESULTS

Data were obtained from health and physiological measurements and questionnaire responses. The questionnaire was evaluated PA level, smoking behaviour, and eating habits. All participants were from KSA. The study participants consisted of 101 individuals, 75 former athletes and 26 non-athletes (aged 26-60 years), who have volunteered to participate in this study. Baseline characteristics are listed in Table 1 for the former athletes and non-athletes for age, height, weight, BMI, smoking status, eating fast food and PA.

Mean (SD) age of former athletes was 41.97 years (SD=7.54), and that of the non-athletes was 41.58 years (SD=9.01) ( $p = 0.245$ ), former athletes were older than non-athletes. Mean (SD) BMI of the former athletes was 28.33kg/m<sup>2</sup>

(SD=4.67), while the corresponding value for non-athletes was 29.86 kg/m<sup>2</sup> (SD=5.33) ( $p = 0.494$ ). Mean (SD) weight of former athletes was 86.64 kg (SD=16.35), while non-athletes' group was 87.52 kg (SD=18.07) kg ( $p < 0.776$ ). Mean (SD) height of former athletes was 175 cm (SD=8.02) while for non-athletes was 170.96 cm (SD=6.15) ( $p < 0.139$ ). Former athletes had lower weight and BMI than non-athletes, but they were taller than non-athletes. With regard to smoking status, (36.00%) of former athletes and (15.38%) of non-athletes were smokers. In addition, (73.33%) of former athletes and (73.08%) of non-athletes were reported to eat fast food.

Anthropometric and biological characteristics and prevalent cases of MS and UA data of former athletes and non-athletes are shown in Table 2. Based on the study results, no significant differences were found between former athletes and non-athletes in regard MS ( $p = 0.127$ ), although former athletes had higher prevalence of MS (38.61%) compared to non-athletes (17.82%) (Fig.1). With regard to the prevalence of overweight and obesity, (31.68%) of former athletes were overweight and (26.73%) were obese, while for non-athletes the prevalence of overweight and obesity was (9.90%) (Fig.2).

With regard to the mean of BMI, former athletes had lower average BMI ( $28.33 \pm 4.67$ ) than non-athletes ( $29.86 \pm 5.33$ ). The study results indicated that no statistically differences were found between former athletes and non-athletes ( $p = 0.494$ ).

In regard to the mean of WC, non-athletes had higher average WC ( $97.95 \pm 13.45$ ) than former athletes ( $93.84 \pm 12.81$ ). The study results indicated that no statistically differences were found between former athletes and non-athletes ( $p = 0.167$ ).

With regard to the mean of FBG, former athletes had lower average FBG ( $112.01 \pm 34.32$ ) than non-athletes ( $115.81 \pm 27.46$ ). The study results indicated that no statistically differences were found between former athletes and non-athletes ( $p = 0.611$ ).

With regard to the mean of systolic/diastolic blood pressure, former athletes had higher average of systolic blood pressure ( $123.52 \pm 12.59$ ) than non-athletes ( $122.69 \pm 14.52$ ). However, former athletes had lower diastolic blood pressure ( $84.09 \pm 9.29$ ) than non-athletes ( $84.27 \pm 11.51$ ). The study results indicated that no statistically differences were found between

former athletes and non-athletes in regard to systolic/diastolic blood pressure ( $p < 0.782$ ) and ( $p = 0.938$ ), respectively.

With regard to the mean of HDL, former athletes had higher average of HDL ( $24.23 \pm 8.36$ ) than non-athletes ( $20.46 \pm 7.42$ ). The study results indicated that statistically significant differences were found between former athletes and non-athletes ( $p = 0.045$ ).

With regard to the mean of triglyceride, former athletes had higher average of triglyceride ( $114 \pm 77.73$ ) than non-athletes ( $95.04 \pm 61.95$ ). The study results indicated that no statistically significant differences were found between former athletes and non-athletes ( $p = 0.243$ ).

With regard to the mean of UA, former athletes had lower average of UA ( $6.35 \pm 1.33$ ) than non-athletes ( $7.26 \pm 1.44$ ). The study results indicated that statistically significant differences were found between former athletes and non-athletes ( $p = 0.004$ ).

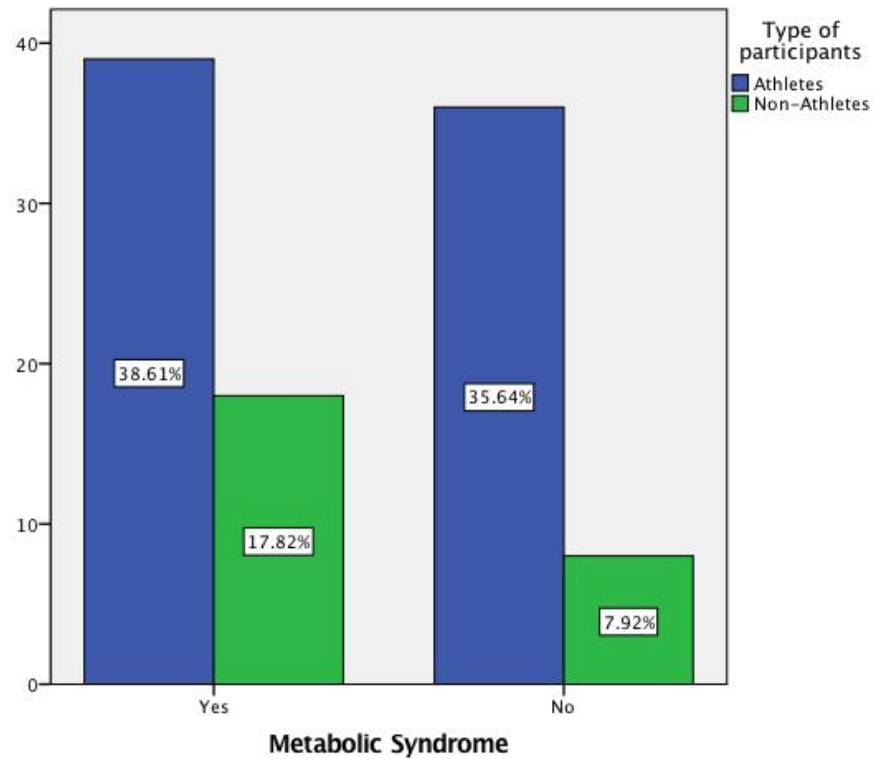
With regard to LTPA, 20.79% of former athletes have participated in high LTPA, while 28.71% and 24.75% have participated in moderate and low LTPA, respectively. However, 4.95% of non-athletes have participated in high LTPA, whereas, 9.90% and 10.89% have participated in moderate and low LTPA, respectively. Former athletes had higher prevalence of moderate and low LTPA compared to high LTPA (Fig. 3).

#### 4. DISCUSSION

In recent years, MS and high BMI become a worldwide issues and they have been documented as risk factors for several health problems and unfavourable health consequences; high UA is one of these issues [8]. Currently, high BMI and high UA and its issues, such as MS and CVD, have raised serious concern for public health worldwide because of their wide spread, health consequences and substantial economic burden. Many health studies have investigated the prevalence of MS among former athletes; however, to our knowledge, this is the first study to assess the prevalence of MS and UA and to look at the effects of previous high intensity training among former athletes in KSA. Therefore, this study was designed to compare the prevalence of MS, overweight and obesity, UA, and LTPA between former athletes and non-athletes and to determine the effects of pervious exercise on MS and UA.

**Table 1. Anthropometric and life-style variables of the sample, according to group (expressed as mean ± SD or n, with their corresponding percentages %)**

	Former athletes (N = 75)	Non-athletes (N = 26)	P-value
Age mean ± SD	41.97 ±7.54	41.58 ±9.01	.245
Height mean ± SD	175.43 ±8.02	170.96 ±6.15	.139
Weigh mean ± SD	86.64 ±16.35	87.52 ±18.07	.776
BMI mean ± SD	28.33 ±4.67	29.86 ±5.33	.494
Underweight	4.00%	-	
Normal weight	17.33%	23.08%	
Overweight	42.67%	38.46%	
Obesity	36.00%	38.46%	
Smoking status (%)	36.00%	15.38%	
Fast food (%)	73.33%	73.08%	
<b>Physical activity level</b>			
High	28.00%	19.23%	
Moderate	38.67%	38.46%	
Low	33.33%	42.31%	



**Fig. 1. Prevalence of metabolic syndrome among former athletes and non-athletes**

Participants with three or more risk factors of MS in the current study were considered to have MS according to the definition of the NCEP ATP III [2,5]. The current study revealed a high prevalence of MS among former athletes. According to the study results, 58.41% of former athletes and 19.8% of non-athletes had a BMI ≥ 25 kg/m<sup>2</sup>. High BMI value is associated with a

high risk of developing MS, the findings of this study highlight the possible risk of MS and the development of the non-communicable diseases between the study participants. According to earlier findings, former athletes had lower BMI value than non-athletes [3,4,17]. The result of this study is consistent with the findings of previous researches.

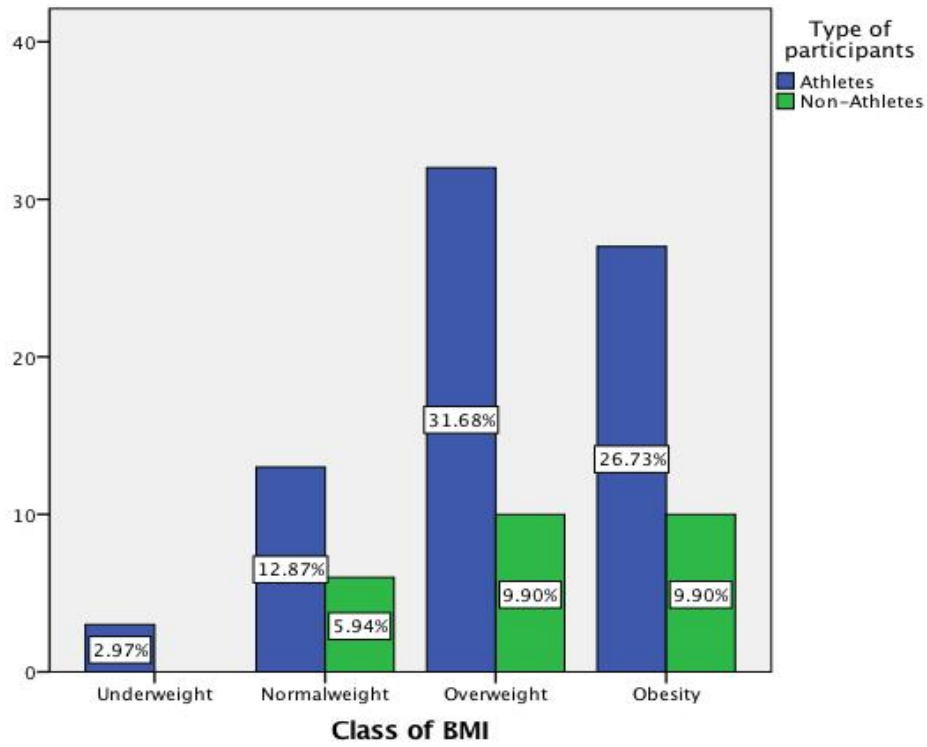


Fig. 2. Prevalence of body mass index among former athletes and non-athletes

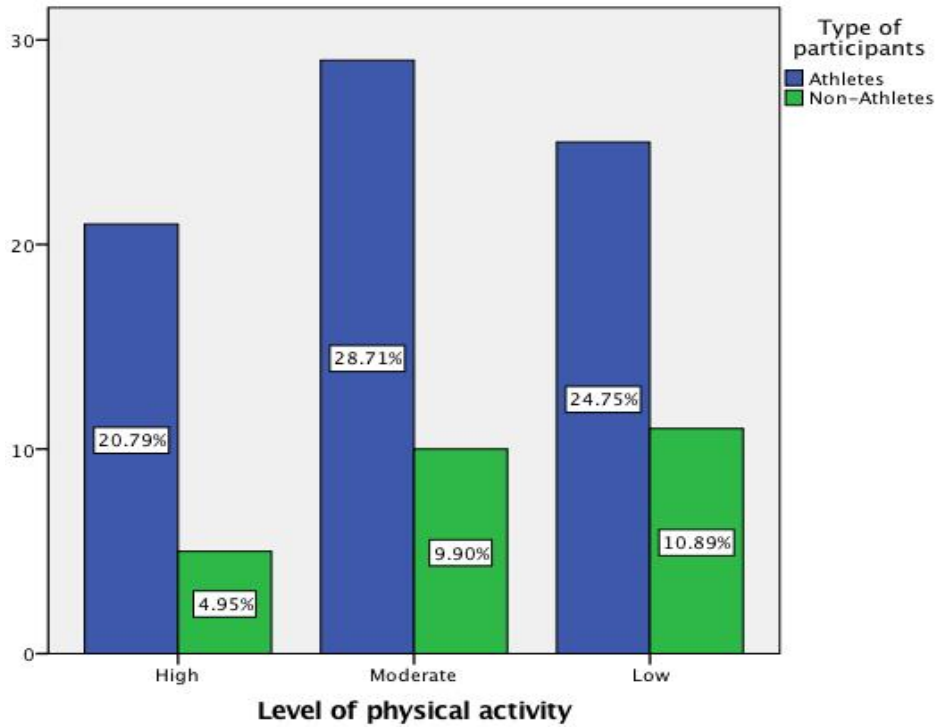


Fig. 3. Prevalence of physical activity level among former athletes and non-athletes

**Table 2. Anthropometric/biological characteristics and prevalent cases of metabolic syndrome and uric acid. Data are means  $\pm$  SD <sup>a</sup> or percentages <sup>b</sup>**

	<b>Former athletes (N = 75)</b>	<b>Non-athletes (N = 26)</b>	<b>P-value</b>
Body mass index (mean $\pm$ SD) <sup>a</sup>	28.33	29.86	.494
Overweigh (%)	31.68%	9.90%	-
Obesity (%)	26.73%	9.90%	-
Waist (cm) <sup>a</sup>	93.84	97.95	.167
>102cm (%) <sup>b</sup>	19.80%	9.90%	-
Triglycerides(mg/dL) <sup>a</sup>	114.84	95.04	.243
$\geq$ 150 mg/dL, or on medication (%) <sup>b</sup>	16.83%	3.96%	-
HDL cholesterol (mg/dL) <sup>a</sup>	24.23	20.46	.045
<40 mg/dL, or on medication (%) <sup>b</sup>	69.31%	24.75%	-
Systolic blood pressure (mmHg) <sup>a</sup>	123.52 (mmHg)	122.69 (mmHg)	.782
Diastolic blood pressure (mmHg) <sup>a</sup>	84.09 (mmHg)	84.27 (mmHg)	.938
$\geq$ 130/85 mmHg, or on medication (%) <sup>b</sup>	35.64%	12.87%	-
Fasting glucose (mg/dL) <sup>a</sup>	112.01 (mg/dL)	115.81 (mg/dL)	.611
$\geq$ 100 mg/dL, or on medication (%) <sup>b</sup>	49.50%	20.79%	-
Uric acid (mg/dL) <sup>a</sup> $\geq$ 7 mg/dL, or on medication (%) <sup>b</sup>	6.35 (mg/dL)	7.26 (mg/dL)	.004
With metabolic syndrome (%) <sup>b</sup>	38.61%	17.82%	-

Globally, the frequency of MS was reported to be between 10%-84%, depending on the gender, age, and ethnicity of participants [20]. In a study conducted in Finland in 2008 that included 599 participants (392 former athletes and 207 non-athletes), 51% of former athletes had a risk of MS compared with 64.7% of non-athletes [3]. Our data showed that 38.61% of former athletes and 17.82% of non-athletes had three or more risk factors for MS. The most common risk factors were FBG, low HDL, and SBP and DBP.

The study results showed that no significant differences were found between former athletes and non-athletes, although non-athletes had higher average WC ( $97.95 \pm 13.45$ ) than former athletes ( $93.84 \pm 12.81$ ). The study finding of Chang and colleagues was consistent with our results regarding WC [12].

Several studies have reported that high levels of PA are associated with lower levels of FBG. According to the study results no significant differences were found between former athletes and non-athletes in respect to FBG. However, the study findings showed that former athletes had lower average blood glucose than non-athletes. Our result is in consistent with a study by Batista et al. [4,10] who have also reported that FBG levels in former athletes was lower compared to non-athletes [10]. Furthermore, Chang et al. [12] reported that retired athletes had lower FBG than control group [12]. Long term PA and ideal BMI may be the underlying for reducing the risk of high FBG.

The study findings indicated that former athletes had higher average of systolic blood pressure than non-athletes. On the other hand, former athletes had lower diastolic blood pressure than non-athletes. The study results indicated that no significant differences were found between former athletes and non-athletes in regard to systolic/diastolic blood pressure. Our findings for systolic blood pressure is consistent with an earlier study conducted by Chang et al. [12] which reported that former athletes had higher mean of systolic blood pressure than control group. This could be attributed to the size and age of former athletes because former athletes are a bit older than non-athletes and also former athletes are taller than non-athletes. On the other hand, for diastolic blood pressure our result is consistent with previous studies which showed that former athletes had lower mean of diastolic blood pressure than non-athletes [4,10,12,21]. According to Batista & Soares, high intensity PA

may play a significant role in lowering diastolic blood pressure [4].

According to the study results, most of former athletes had a low HDL. The current findings showed that a significant statistical difference was found between former athletes and non-athletes. Former athletes had higher mean of low HDL than non-athletes. Our results are consistent with a previous study which reported that former athletes had higher mean of HDL than non-athletes [12]. Low HDL can be attributed to the effect of consuming unhealthy food as unhealthy foods is a risk factor for many long-term diseases such as high BP, T2D, CVD [9,22], according to the current study results an overwhelming majority of the study participants were eating fast food which might be the cause of low HDL. However, participating in adequate PA is associated with high level of HDL [3].

The study results showed that no significant differences were found between former athletes and non-athletes in regard to triglyceride. However, former athletes had higher mean of TG than non-athletes. Previous studies have reported that PA is associated with lower blood lipids level including triglyceride [3,9]. Our finding is inconsistent with early studies in former athletes which reported that former athletes tend to have lower triglyceride than non-athletes [3,4,9,12]. Our finding is inconsistent with previous results and this may attribute to the effects of the body size of former athletes and the food habits as we mentioned above.

A significant difference was found between former athletes and non-athletes in regard to UA. Former athletes had lower mean of UA than non-athletes. There are limited studies on the prevalence of UA among former athletes as well as the effects of previous participation in high intensity training. However, numerous studies have reported that high level of UA can be an independent predictor of CVD and MS [23–25]. According to Park et al. [26], there are various factors can lead to elevated UA for instance genetic factors, high alcohol drinking, consumption of high calories food, physical inactivity, and sedentary lifestyle. However, participating in regular PA can reduce the risk of MS and high level of UA [2,5,26]. The underlying mechanisms of reducing UA level via increase PA still unclear, however, it has been suggested that PA may reduce UA excretion and speed up purine degradation. Moreover, PA can increase insulin sensitivity, which may be mediating the



relationship between PA and UA level. Routine PA is recommended for lowering body weight, which is generally good for abnormal metabolic factors such as UA, and further decreasing the risk of various chronic diseases such as CVD [27].

The inconsistency of some of our results with previous studies may be attributed to differences in lifestyle selections and dietary habits, as the majority of the studies were carried out in the USA and Europe. Many factors can justify the high prevalence of MS among retired athletes, including environmental factors, such as the weather conditions; fast food consumption; and inappropriate lifestyle behaviours, such as a low level of PA, which contributes to obesity that triggers high BP, high blood glucose, high serum cholesterol, and low HDL [5].

The present study has some limitations, one of the limitations is including the small sample size and the time limit due to the outbreak, however, future research can be conducted on a larger sample and may include different types of sports to determine the effects of previous exercise on prevalence of MS and its risk factors and UA. In addition, information on LTPA, smoking, and dietary habits were self-reported which may lead to some bias. Self-report of LTPA has been reported to be lower and higher than directly measured. Participants more likely to overestimate their vigorous physical activities and underestimated their light physical activities, however, on average, the reliability and validity of the questionnaire is better in groups than in individuals [3,28]. Moreover, the findings of our study may not apply to other ethnic populations. Our study recommends regular screening for MS and its risk factors. Data obtained from screening could be used by healthcare stakeholders and researchers in layout educational programs to reduce the risk of MS and its risk factors. This might help prevent the development of chronic diseases, which could affect quality of life and have economic burden in respect of public healthcare.

## 5. CONCLUSION

Our study is one of the few studies on MS and its risk factors among former athletes in the Middle East and Arab countries and the first to determine the prevalence of UA among former athletes. It was found that MS prevalence is high among former athletes compared to non-athletes. Former athletes had lower BMI and WC

and better fasting blood glucose, HDL, and UA compared to non-athletes. Therefore, being an athlete may give some positive effects on the health outcomes.

## AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

## CONSENT AND ETHICAL APPROVAL

This study was approved by a panel of experts who were considered as an ethics committee for the school of education at University Technology Malaysia (UTM). The researchers explained the content of the consent document to participants of the study with assurance of confidentiality.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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