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The Association between serum uric acid levels and dyslipidemia in patients attending family medicine clinics at King Khalid University Hospital

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Abstract

Introduction:

The last enzymatic byproduct of purine metabolism is uric acid. There is mounting evidence that dyslipidemia is strongly correlated with high serum uric acid (SUA) rates or hyperuricemia.

Objectives:

1. To estimate the prevalence of dyslipidemia and hyperuricemia among patients visiting family medicine clinics in KKUH, Riyadh Saudi Arabia.

2. To investigate a correlation between dyslipidemia and hyperuricemia levels in patients attending family medicine clinics.

3. To compare different variables; age, gender, associated diseases e.g. (HTN,DM, Hypothyroidism...) in relation to uric acid and lipid levels.

Methods:

Our study is a Cross-sectional descriptive retrospective study to review medical records of patients attending family medicine clinics in a period of one year (January - december 2019) who have hyperuricemia and then study the association between dyslipidemia and hyperuricemia. we are used database of KKUH Clinics, Riyadh Saudi Arabia Targeted both male and female patients of 18 years old and older age groups. Medical records of patients with three visits and more with laboratory results of uric acid and lipids were included in the review. Our exclusion criteria include the participants with incomplete clinical data. The study conducted after the IRB approval and access to patients' files is approved by KSUMC authority. Statistical analysis performed by SPSS (version 22 IBM, SPSS Inc., NY, USA)

Results: Age and gender have an effect on the connection between SUA levels and dyslipidemia, which is significant.

Conclusion: We concluded that higher SUA levels were strongly associated with dyslipidemia and its components and that this association is influenced by age and gender for the first time.

Keywords: age, dyslipidemia, gender, hyperuricemia, uric acid

ملخص البحث :

مقدمة:

آخر نتيجة ثانوية إنزيمية لاستقلاب البيورين هو حمض البوليك. هناك أدلة متزايدة على أن عسر شحميات الدم يرتبط ارتباطًا وثيقًا بارتفاع معدلات حمض اليوريك في الدم (SUA) أو فرط حمض يوريك الدم.

أهداف:

1 .لتقدير انتشار دسليبيدميا وفرط حمض يوريك الدم بين المرضى الذين يزورون عيادات طب الأسرة في KKUH، الرياض المملكة العربية السعودية.

2 .التحقق من وجود علاقة ارتباط بين عسر شحميات الدم ومستويات فرط حمض يوريك الدم في المرضى الذين يترددون على عيادات طب الأسرة.

3. لمقارنة المتغيرات المختلفة. العمر والجنس والأمراض المرتبطة بها مثل (HTN، DM ، قصـــور الغدة الدرقية ...) فيما يتعلق بمستويات حمض البوليك والدهون.

طُرق:

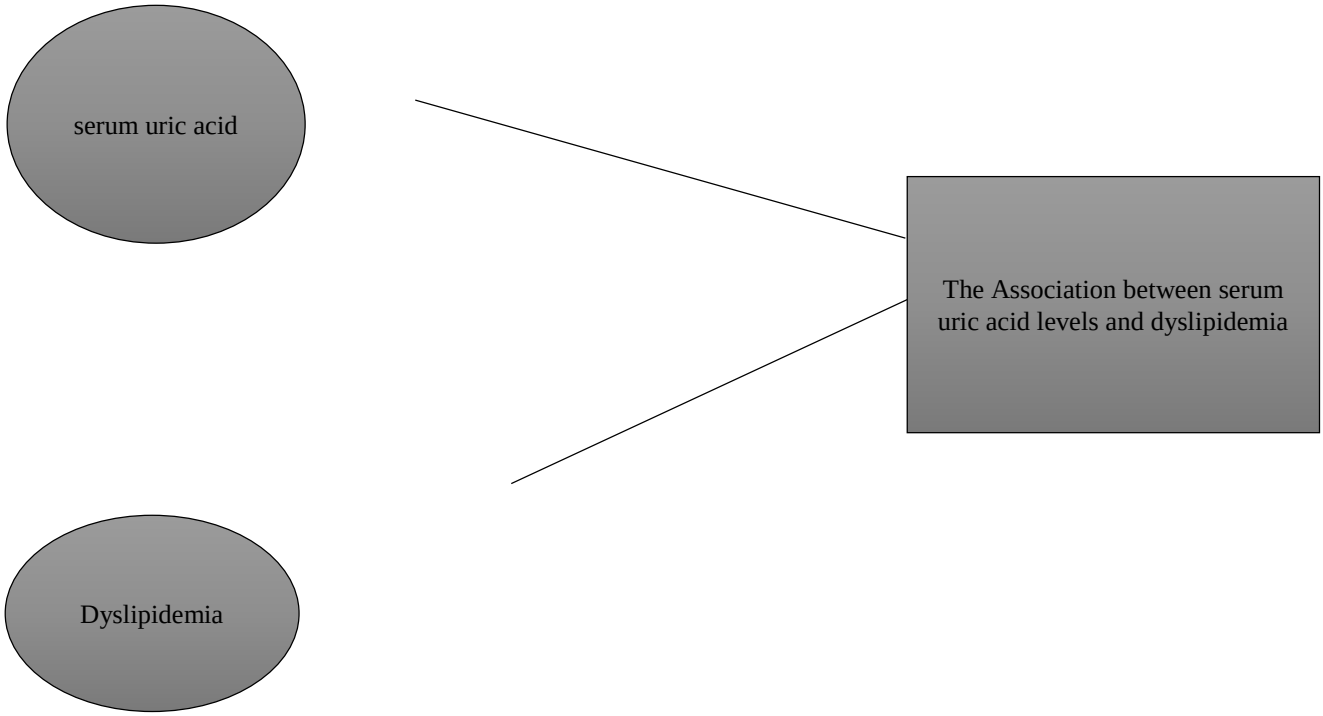
دراستنا عبارة عن دراسة مقطعية وصفية بأثر رجعي لمراجعة السجلات الطبية للمرضى الذين يحضرون إلى عيادات طب الأسرة في فترة عام واحد (يناير – ديسمبر 2019) الذين يعانون من فرط حمض اليوريك في الدم ثم دراسة الارتباط بين عسر شحميات الدم وفرط حمض يوريك الدم. نحن نستخدم قاعدة بيانات عيادات KKUH ، الرياض المملكة العربية السعودية تستهدف كل من المرضى من الذكور والإناث من الفئات العمرية 18 سنة وما فوق. تم تضمين السجلات الطبية للمرضى مع ثلاث زيارات وأكثر مع النتائج المختبرية لحمض البوليك والدهون في المراجعة. تشمل معايير الاستبعاد الخاصة بنا المشاركين الذين لديهم بيانات إكلينيكية غير كاملة. الدراسة التي أجريت بعد موافقة IRB والوصول إلى ملفات المرضى من قبل هيئة KSUMC. التحليل الإحصائي الذي تم إجراؤه بواسطة) SPSSالإصدار 22 IBM، SPSS Inc.، نيويورك ، الولايات المتحدة الأمريكية) .

النتائج: العمر والجنس لهما تأثير على العلاقة بين مستويات SUA وخلل شحميات الدم ، وهو أمر مهم.

الخلاصة: خلصنا إلى أن المستويات الأعلى من SUA كانت مرتبطة ارتباطًا وثيقًا بعسر شحميات الدم ومكوناته وأن هذا الارتباط يتأثر بالعمر والجنس لأول مرة.

الكلمات المفتاحية: العمر ، عسر شحميات الدم ، الجنس ، فرط حمض اليوريك في الدم ، حمض البوليك.

Rough Conceptual Model



serum uric acid: A blood test for uric acid, also called a serum uric acid measurement, measures the amount of uric acid present in the body. The results of the test can reveal how effectively the body produces and excretes uric acid. The chemical uric acid is created by the body when purine-containing foods are broken down by the body.

Dyslipidemia: Atherosclerosis is facilitated by dyslipidemia, which is an increase in plasma cholesterol, triglycerides (TGs), or both, or a low amount of high-density lipoprotein cholesterol. Primary (genetic) or secondary causes are both possible. Plasma levels of total cholesterol, TGs, and specific lipoproteins are measured to make a diagnosis. Lipid-lowering medications, exercise, and dietary changes are all part of the treatment.

Introduction

Cardiovascular disease is the world's largest cause of mortality, and dyslipidemia is a controllable risk factor for it. Obesity, type 2 diabetes, metabolic syndrome (MetS), and nonalcoholic fatty liver disease are all important public health concerns that can affect people all over the world and are all directly linked to dyslipidemia. With changes in lifestyle brought on by economic growth, dyslipidemia has become more common during the past few decades in the majority of emerging nations (Zhang M, et al. 2018, pp. 196-203).

The last enzymatic byproduct of purine metabolism is uric acid. A growing body of research suggests that dyslipidemia and increased serum uric acid (SUA) levels, often known as hyperuricemia, are closely related. The findings of recent studies that point to a potential link between SUA rates and dyslipidemia, however, are still debatable. Hypercholesterolemia, hypertriglyceridemia, and low high-density lipoprotein cholesterolemia are all disorders that fall under the general term "dyslipidemia" (low HDL-cholesterolemia) (Gonçalves JP, et al. 2012, p.7). Because some research indicated that SUA levels were considerably closely connected with triglyceride (TG) but not high-density lipoprotein cholesterol, the relationship between SUA levels but every component of dyslipidemia is still not entirely understood (HDL-cholesterol). It is also unclear whether there is a consistent association between SUA levels and dyslipidemia across different genders, which is something to take into account. In a recently cohort study, males but not women participants showed a robust positive correlation between SUA levels and dyslipidemia. In order to learn more about the connection between SUA levels and dyslipidemia, more research is therefore necessary (Kuwabara M, et al. p.44).

In this study, we first sought to examine the relationship between SUA levels and dyslipidemia and its components. We next sought to examine the relationship between SUA levels and dyslipidemia in relation to sex and age in a large sample of Saudis who were 18 years of age and older. In order to validate our findings, we also investigated recently published research that assessed the relationship between SUA and dyslipidemia.

Research problem:

Cardiovascular disease is the world's largest cause of mortality, and dyslipidemia is a controllable risk factor for it. Obesity, type 2 diabetes, metabolic syndrome (MetS), and nonalcoholic fatty liver disease are all important public health concerns that can affect people all over the world and are all directly linked to dyslipidemia. With changes in lifestyle brought on by economic growth, dyslipidemia has become more common during the past few decades in the majority of emerging nations.

The enzymatic byproduct of purine metabolism that remains is uric acid. There is mounting evidence that dyslipidemia is highly correlated with higher serum uric acid (SUA) levels, often known as hyperuricemia. The findings of current research, however, that point to a potential connection between dyslipidemia and SUA levels are still debatable. Dyslipidemia, a catch-all name for a variety of illnesses, includes hypercholesterolemia, hypertriglyceridemia, and low high-density lipoprotein cholesterolemia (low HDL-cholesterolemia). Because some research indicated that SUA levels were considerably closely connected with triglyceride (TG) but not high-density lipoprotein cholesterol, it is still unclear how each component of dyslipidemia and SUA levels relate to one another (HDL-cholesterol).

It is also not clear whether the relationship between SUA levels and dyslipidemia holds consistent across different genders, which merits consideration. One recent cohort study established a strong positive association between SUA levels and dyslipidemia in man but not in women participants. Therefore, it does merit further study to determine more about the association between SUA levels and dyslipidemia.

Study hypotheses:

- There is a statistically significant association between dyslipidemia and hyperuricemia levels in patients attending family medicine clinics.
- There is a statistically significant relationship to demographic variables. Age, gender and associated diseases (HTN, DM, hypothyroidism ...) in relation to uric acid and lipid levels.

The Association between serum uric acid levels and dyslipidemia

High uric acid levels are used to predict many diseases, including left atrial thrombus, and they may be an indicator of patients who are aspirin-resistant. It might also be employed as a biochemical index to identify adolescent depression. In chronic kidney disease, a high uric acid level is a known risk factor for a decline in renal function. It is also a risk factor for cardiovascular disease and found to be connected with higher arterial stiffness (Li, N. F.,2009).

It is generally recognized that high blood pressure, metabolic syndrome, coronary artery disease, and stroke are all strongly correlated with blood uric acid levels. Given its relationship with numerous other risk variables like nutrition, obesity, and dyslipidemia, the precise function of serum uric acid in these diseases has not yet been established. Investigations into the role of serum uric acid in the pathophysiology and prevalence of cardiovascular disease and metabolic syndrome are necessary in light of emerging data fragments that indicate a rapid rise in the prevalence of hyperuricemia in international communities (Cardoso, A. S.,2013).
Only a few studies to date have connected dyslipidemia to serum uric acid, including those that looked at the adult populations of Bangladesh, India, Italy, China, and the United States of America. This is despite the fact that risk factors for metabolic syndrome and cardiovascular disease are rigorously studied. The connection between dyslipidemia and serum uric acid in the general population is not well understood, despite the high frequency of hyperuricemia (11.4%) in the Korean population.

Cardiovascular disease is the world's leading cause of death, and dyslipidemia is a modifiable risk factor for it. Obesity, type 2 diabetes, metabolic syndrome (MetS), and nonalcoholic fatty liver disease are all serious public health concerns that can affect people all over the world and are all closely linked to dyslipidemia. With changes in lifestyle brought on by economic growth, dyslipidemia has become more common during the past few decades in the majority of emerging nations (Vekic, J.,.2009).
The last enzymatic byproduct of purine metabolism is uric acid. A growing body of evidence suggests that dyslipidemia and elevated serum uric acid (SUA) levels, also known as hyperuricemia, are closely related. The findings of recent studies that point to a potential link between SUA levels and dyslipidemia, however, are still debatable. Hypercholesterolemia, hypertriglyceridemia, and low high-density lipoprotein cholesterolemia are all disorders that fall under the general term "dyslipidemia" (low HDL-cholesterolemia). Because some research

indicated that SUA levels were considerably closely connected with triglyceride (TG) but not high-density lipoprotein cholesterol, the relationship between SUA levels and each component of dyslipidemia is still not entirely understood (HDL-cholesterol)

Today, hyperuricemia is recognized as a significant risk factor for cardiovascular disease, metabolic syndrome, chronic renal disease, and hypertension. The rupture of serum uric acid homeostasis may be linked to cardiovascular risk and all-cause mortality, despite serum uric acid's historical reputation as an oxygen radical scavenger. Serum uric acid currently plays a crucial role in modulating glucose and lipid metabolism. Recent research suggests that serum uric acid levels may serve as early indicators of metabolic syndrome and, when paired with LDL-C, of hypertension (Kim, J. W.,2017).

In spite of the clinical history of gout, there has been some dispute over the independent function of serum uric acid as a novel risk factor and a target for treatment. Despite mounting evidence, there is still no general agreement on whether treating asymptomatic hyperuricemia is worthwhile or not.

Even after controlling for numerous laboratory and clinical confounders, hyperuricemia was still statistically significantly associated with a number of studies' specific dyslipidemia components. Three prior cross-sectional investigations found similar findings. Serum apolipoprotein B levels, triglyceride to HDL-C ratio, and B to apolipoprotein A1 ratio were substantially associated with serum uric acid levels in the study by Peng et al., however serum HDL-C levels were negatively correlated with the study by Ali et al. Apolipoprotein B and apolipoprotein A1 were not included in the data set, however similar findings to the previous study were still obtained.

It is important to note that the association between dyslipidemia and serum uric acid levels is more pronounced in male participants. Whether gender distinctions mediate the association has generated debate in studies to date. According to a study by Stelmach et al. on Polish people with hyperuricemia, males but not females had greater triglyceride values in the upper tertile of serum uric acid levels (Stelmach, M. J.,.2015) According to a retrospective study by Lippi et al., triglycerides and serum uric acid levels are associated in women but not in men, showing conflicting results. In this regard, both male and female groups' triglyceride and serum uric acid levels were positively correlated, according to the findings of our study (Bertoldi, E. G.,2016).

Method

Our study is a Cross-sectional descriptive retrospective study to review medical records of patients attending family medicine clinics in a period of one year (January - december 2019) who have hyperuricemia and then study the association between dyslipidemia and hyperuricemia. We used database of KKUH Clinics, Riyadh Saudi Arabia Targeted both male and female patients of 18 years old and older age groups. Medical records of patients with three visits and more with laboratory results of uric acid and lipids were included in the review. Our exclusion criteria include the participants with incomplete clinical data. The study conducted after the IRB approval and access to patient's files is approved by KSUMC authority. Statistical analysis performed by SPSS (version 22 IBM, SPSS Inc., NY, USA).

Ethical permission was obtained from the ethics committee of the first affiliated hospital, College of Medicine, King Saud University. Due to the observational nature of the study, written consent was not required. Personal information was anonymized during data collection and analysis.

Results

Two hundred and ninety-eight medical records of patients attending the family medicine clinics at KKUH were reviewed retrospectively. The resulted descriptive analysis of the patient's sociodemographic characteristics is shown in the table—1, most of the patients 53% were females and 47% of them were males. The mean ±SD age in years for the sample of patients was equal to 56.72 ± 14.36 years, however their age groups were as follows: 7% of them were aged between 20—34 years, another 15.8% of them were aged between 35—44 years, but another 19.5% of the patients were aged between 45—54 years and 29.9% between 55—64 years but the remainder of the patients 27.9% were aged >=65 years. Most of the patients 76.5% were ever married and most of them 73.2% were Saudi Citizens and the remainder 26.8% of them were indeed expatriates residing and working in the Kingdom.

Furthermore, By investigating the nationality of each patient's medical records it was found that 82.2% of the descended from middle eastern origins, another 6.1% of them were either Indian or Pakistani citizens and 8.7% of them from indo—Asian or Asian origins, however 3% of the patients were from African countries.

The mean ±SD weight (Kg) for the sample of patients was equal to 76.50 ±17.87 Kilograms, and the mean height (metres) for them was equal to 1.62 ±0.1 metres , however the estimated body mass index (BMI) for the sample of patients showed that their mean BMI was slightly raised and it was equal to 29.62 percent with an SD= 6.39 percent, and by considering the classification of their BMI index levels it was found that 2% of them were considered as underweight, another 20.1% of them however were considered to have Normal Body Mass, and most of them 36.9% were considered to be overweight however 21.8% of them were considered to have Obesity Class I and 19.1% of them were considered to have been with obesity class II or III nevertheless . The first visit systolic blood pressure for the sample of patients was measured with a mean score of 134.26 mmhg, SD= 15.76 mmhg, and their mean diastolic blood pressure was measured with a mean score of 75.72 mmhg , SD=10.16 mmhg , however by considering their first visit Mean Arterila Blood pressure (MAP) it was found that their mean MAP score upon admission time was equal to 95.23 mmhg, SD=10.02 highlighting a raised initial admission time mean hemodynamic blood pressure.

In addition, the medical records review process showed that 90.6% of the patients were chronically comorbid, and the multiple response dichotomies analysis findings showed that 65.9% of them were diagnosed with hypertension requiring antihypertensive treatment, 59.6% of them were diagnosed with diabetes undertaking treatments, but another 12.6% of them were identified to be pre—diabetic, and 17% of them had been diagnosed with hypothyroidism requiring treatments, nonetheless 7% of the had been diagnosed to have chronic low vitamin D deficiency and 4.4% with cardiac disease, and another 4.8% diagnosed with bone diseases, and 3% of them were known to have chronic kidney disease (CKD), but also 2.2% of them had been identified to have malignant obesity requiring medical interventions and 1.9% of them diagnosed with chronic Asthma , however 12.6% of the patients had other less frequent chronic diseases, see figure-A.

Table—1: Descriptive analysis of the patients sociodemographic characteristics and admission findings . N=298		
	Frequency	**Percentage**
Sex		
Female	158	53
Male	140	47
Age (years), mean (SD)		56.72 (14.36)
Age group		
20—34 years	21	7
35—44 years	47	15.8
45—54 years	58	19.5
55—64 years	89	29.9
=>65 ye	83	27.9
Marital state		
Never married	70	23.5
Ever married	228	76.5
Nationality		
Non—Saudi	80	26.8
Saudi	218	73.2
Ethnicity		
Middle eastern	244	82.2
Indian/Pakistani	18	6.1
Asian	26	8.7
African	9	3
Weight (Kg), mean (SD)		76.50 (17.87)
Height (meters), mean (SD)		1.62 (0.10)
Body Mass Index, mean (SD)		29.62 (6.39)

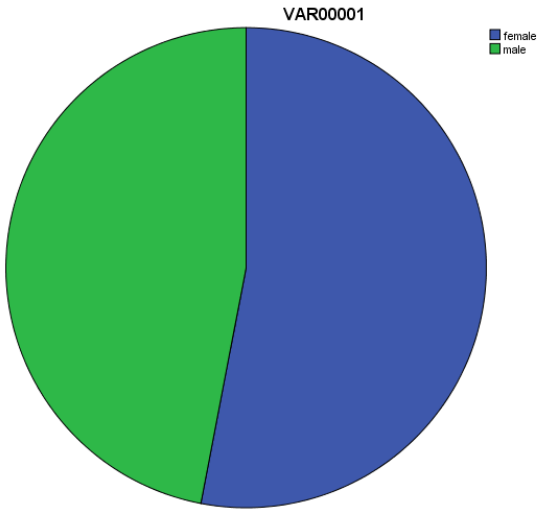
Body Mass Index Level		
Underweight	6	2
Normal	60	20.1
Overweight	110	36.9
Obese class I	65	21.8
Obese class II or III	57	19.1
Admission time Systolic Blood Pressure, mean (SD)		134.26 (15.76)
Admission time Diastolic Blood Pressure, mean (SD)		75.72 (10.16)
Mean Arterial Blood Pressure, mean (SD)		95.23 (10.02)
Comorbid		
No	28	9.4
Yes	270	90.6
Comorbidity type		
Hypertension (HTN)	178	65.9
Diabetes on treatment (DM)	161	59.6
Hypothyroidism	46	17
Other disease	34	12.6
Pre—diabetes	34	12.6
Vitamin D Deficiency	19	7
Osteoporosis / Osteomalacia/Osteopenia/Osteoarthritis	13	4.8
Cardiac Disease (IHD/CHF/CAD/dysrhythmia)	12	4.4
Chronic Kidney Disease	8	3
Obesity Requiring Intervention	6	2.2
Asthma	5	1.9
Other disease	34	12.6
	%	x

Hypertension (HTN)	65.9	
Diabetes on treatment (DM)	59.6	
Hypothyroidism	17	
Other disease	12.6	
Pre—diabetes	12.6	
Vitamin D Deficiency	7	
Osteoporosis / Osteomalacia/Osteopenia/Osteoarthritis	4.8	
Cardiac Disease (IHD/CHF/CAD/dysrhythmia)	4.4	
Chronic Kidney Disease	3	
Obesity Requiring Intervention	2.2	
Asthma	1.9	

Table-2: Descriptive analysis of the patients admission and follow up measured laboratory findings

	Mean (SD)			
	1st Reading	**2nd reading**	**3rd Reading**	**Overall**
Serum Uric Acid (mg/dl) , mean (SD	310.68 (88.71)	311.12 (83.74)	206.832 (54.52)	286.98 (62.52)
Serum LDL (mg/dl) , mean (SD	104.65 (36.53)	102.15 (36.16)	99.98 (37.84)	102.26 (30.80)
Serum HDL (mg/dl) , mean (SD	49.16 (14.35)	50.47 (14.46)	50.49 (15.10)	50.19 (13.84)
Serum Total cholesterol (mg/dl) , mean (SD	183.95 (39.83)	181 (42.19)	180.30 (42.71)	181.99 (34.99)
Serum Triglyceride (mg/dl), mean (SD)	65.08 (37.61)	63.28 (37.20)	63.47 (41.62)	62.60 (32.52)

1st reading = demission time, 2nd reading = at 2-3 months , 3rd reading =at 4-6 months



The table-2 displays the descriptive analysis (means and standard deviations) of the patients repeated measured lipid profile parameters and their serum uric acid at three time follow up time points, first reading was taken upon admission/presenting to the clinics , second reading was between 2-3 months after initial visits and the third reading was taken at 4-6 months from first visit . The repeated measured ANOVA test showed no statistically significant difference in patients repeated measured mean lipid profile parameters across the three visits time points, neither did their uric acid value had differed significantly between the three clinical visit time points , p-value=1 each respectively . All in all, the fifth column of the table-2 shows the overall mean levels of each of the parameters, the yielded analysis findings showed that the mean overall serum uric acid for the patients was equal to 286.98 ±62.52 mg/dl, but 7.8% of them were considered to have had above normal serum uric acid (see table-3) , and their overall mean serum Low density lipoprotein (LDL) was centered at 102.26 ±30.80 mg/dl, and the half of them (50%) were considered to have high serum Low density lipoprotein level , also their mean serum high density Lipoprotein (HDL) level was measured with 50.19 ±13.84 mg/dl , but considering their sex standardized serum HDL levels it was found that 37.9% of them were considered to have lower than normal High Density Lipoprotein with no statistically significant difference between females and males with respect to their likelihood of having low HDL levels (Females: 38.2%, Males: 37.6%) according to the chi-squared test of independence, p-value=0.911 . Also, the yielded analysis findings showed that the patients overall mean serum total cholesterol level was measured with 181.99 ±34.99 mg/dl, with 27.5% of them were identified to have above normal serum cholesterol but male and female patients did not differ significantly with respect to their likelihood of high cholesterol , p-value=0.640 . As well the patients overall mean serum Triglyceride (TG) was measured with 62.60 ±32.52 mg/dl, and 9.4% of them were considered to have higher than

normal serum TG level, however the chi-squared test of independence showed that male patients were found to be significantly more inclined to high Triglyceride level (13.5%) compared to females (5.7%), according to the chi-squared test of independence , p-value=0.023.

Table-3: Descriptive analysis of the patients measured Lipid profile findings (overall) . N= 298

	Frequency	Percentage
Uric Acid Level		
Low/Normal	228	76.5
High	70	23.5
LDL Level		
Normal	248	83.2
High	50	16.8
HDL Level (sex standardized)		
Normal	185	62.1
Low	113	37.9
Cholesterol Leve		
Normal	216	72.5
High	82	27.5
Triglyceride Level		
Normal	270	90.6
High	28	9.4

Table-4 : Bivariate Pearson's Correlations between metric measured lab tests and variables

	Uric Acid	LDL	HDL	Cholesterol	Triglyceride	BMI	MAP
Low density Lipoprotein -LDL	-0.02						
High density Lipoprotein -HDL	-.232**	0.03					
Total cholesterol level	-0.03	.886**	.221**				
Blood Triglyceride	.192**	-0.02	-.413**	.261**			
Body Mass Index (BMI) score	.137*	-0.01	-0.07	-0.03	0.04		
Mean Arterial Blood Pressure (MAP) score	.131*	0.03	0.01	0.06	0.04	0.09	
Age (years)	0.04	-.242**	0.02	-.221**	-0.02	.134*	-0.02

. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

The Bivariate Pearson's correlations test , table-4, Showed that the patients mean overall serum uric acid had correlated significantly but Negatively with their overall mean serum High density lipoprotein r= —0.232, p<0.010 , higher serum uric acid predicted significantly lower mean serum HDL level on average . Too, the patients mean serum Uric acid had correlated significantly positively with their mean serum Triglyceride, r= 0.192, p<0.010, also their serum uric acid level had converged positively and significantly but weakly with each of their Body Mass Index , r=0.137, and with their measured admission time Mean arterial Blood pressure (MAP) , r= 0.131, p<0.050 , therefore it can be inferred that as patients mean serum Uric acid tended to rise their serum triglyceride, body mass index and MAP pressure tended to rise incrementally on average too . The patients uric acid, serum LDL and cholesterol levels did Not correlate with each other's significantly according to the bivariate Pearson's correlation test . But, patients serum LDL had correlated positively with their serum total cholesterol , r=0.886, p-value<0.010 and negatively with their age in years , r=—0.242, pM0.010 . The patients serum HDL level had correlated positively with their total cholesterol but negatively with their serum triglyceride levels . From another hand, the patients serum Triglyceride and their blood total cholesterol had correlated positively significantly, r=0.261, p<0.010 , and patients age in years had correlated significantly negatively with their mean blood triglyceride, r=—0.221, p<0.010 . Patients age in years and their body mass Index (BMI score) had correlated weakly but significantly and positively, r=0.134, p<0.050.

DV= HIGH TRIGLYCERIDE

Table-5: Multivariable Binary Logistic Regression Analysis of the patients odds of having High Triglyceride.

	Multivariate adjusted Odds Ratio (OR)	95% C.I. for OR		p-value
		Lower	Upper	
Gender= Male	2.609	1.121	6.072	.026
Age(years)	.969	.936	1.004	.081
Nationality= African	7.489	1.798	31.181	.006
Body Mass (BMI) index	.975	.907	1.048	.491
Marital state=Ever married	7.436	1.458	37.914	.016
Comorbid	1.343	.846	2.131	.211
Prior History of Uricemia	2.445	1.083	5.518	.031
Constant	.015			.005

Dependent outcome variable= High admission Triglyceride (No/Yes)

Note: The other predictor variables and risk factors did Not correlate significantly with this outcome in the multivariate analysis

To understand better what may explain the patients odds of having high triglyceride the multivariable binary logistic regression (MBLR) was used to regress patients odds of having presented with high Triglyceride level (TG) at presenting time against their sociodemographic, disease related, presenting uric acid levels across the three visit times . The yielded multivariate adjusted findings, table-5, showed that the patients sex had converged significantly on their odds of having high TG level , male patients were found to be significantly more predicted (2.61 times more) to present with high TG level compared to females on average, p-value=0.026 . Note the illustration in figure-B , It is clear that males exceeded females with respect to their predicted probabilities of presenting with high TG levels regardless of their medical history of hyperuricemia , well by accounting for the other predictor variables in the analysis model . Also, the patients age (in years) did not correlate significantly with their odds of high TG level, p=0.081, although their age had correlated slightly negatively (OR=0.969) with their odds of having presented with high TG levels in general . Interestingly, patients ethnicity had converged significantly on their odds of having high TG levels, people from African origins were found to be significantly more predicted (

7.4899 time more predicted) to have presented with high TG level compared other people with different ethnic backgrounds on average, p-value=0.006 . Nevertheless, peoples Body Mass Index did Not correlate significantly with the odds of having high blood TG levels, p-value=0.491, neither did their weight and height correlate significantly with their odds of High TG in other iterative models -not shown in the above model . From another hand, the analysis model suggested that ever married people were found to be significantly more predicted to High TG levels (7.44 times higher) compared to never married people, p-value=0.016 . Furthermore, the multivariate findings showed that people's comorbidity did not converge significantly with their odds of having presented with high TG, p-value=0.211, but the patients with positive history of hyperuricemia were found to be significantly more predicted (2.445 times more) to present with high blood TG levels compared to people Not known to have hyperuricemia on average, p-value=0.031 , note figure-b, it is clear that both male and female patients known to have positive history of Uricemia are more predicted to have presented with high TG compared to those with negative history of Uricemia.

Cholesterol=Hi

Table-6: Multivariable Binary Logistic Regression Analysis of the patients odds of having High admission serum cholesterol.

	Multivariate adjusted Odds Ratio (OR)	95% C.I.for OR		p-value
		Lower	Upper	
Gender= Male	.853	.606	1.202	.364
Age(years)	.977	.965	.990	<0.001
Nationality = African	1.791	.765	4.193	.179
Nationality = Indian/Pakistan	1.472	.791	2.736	.222
Nationality =Asian	2.362	1.342	4.159	.003
Body Mass Index score	.992	.964	1.022	.613
Mean Arterial (MAP) Blood Pressure	1.015	.999	1.032	.074
Positive History of Uricemia	.588	.409	.846	.004
Diagnoses with Pre-diabetes	2.113	1.284	3.477	.003
Diagnosed with diabetes and receives treatment	.666	.461	.962	.030
Low HDL profile	.657	.467	.925	.016
Constant	.568			.542

Dependent outcome variable= High admission Cholesterol Level (No/Yes)

Note: The other predictor variables and risk factors did Not correlate significantly with this outcome in the multivariate analysis

Also the Multivariable Binary Logistic Regression analysis was applied to people's odds of presenting with high cholesterol (Chol) levels. The yielded multivariate analysis findings showed that the patients sex did not converge significantly on their odds of presenting with high cholesterol levels, p-value=0.364. But their age in years had correlated significantly and negatively with their odds of presenting with higher than normal cholesterol levels, as people's age tended to rise by one year on average their mean predicted odds of presenting with higher than normal cholesterol levels declined by a factor equal to 2.3% times less on average, p-value<0.001, by considering the other factors as accounted for in the analysis model nevertheless. Patients nationality had correlated significantly with their odds of having presented with above normal cholesterol, however Asian people were found to be significantly more predicted to present with above normal cholesterol blood levels (2.362 times more) compared to Middle Eastern people on average, p-value=0.003, but although African and Indian/Pakistani people measured slightly raised odds of high cholesterol when compared to middle eastern the difference between them were found to be statistically insignificant however. The patient's Body Mass Index (BMI) score did not correlate significantly with their odds of presenting with high cholesterol levels above normal, but their mean arterial Blood pressure (MAP) had correlated slightly positively, though not statistically significantly, with their odds of having been with above normal cholesterol blood levels, p-value=0.074. Surprisingly, patients history of Hyperuricemia had correlated significantly but negatively with their odds of having presented with above normal cholesterol blood levels, hyperuricemia people were found to be (41.2% times less) predicted to present with high blood cholesterol compared to people not known to have hyperuricemia on average, p-value= 0.004, note figure-C for illustration , it is clear that people with hyperuricemia measured significantly lower mean probability of presenting with high cholesterol levels above normal across all age groups, but it is evident that age groups correlated with significant decline in predicted probabilities of high cholesterol levels above normal at presenting times . Prediabetic people were also found to be significantly more predicted to present with higher than normal blood cholesterol (2.11 times more) compared to those not known to be prediabetic on average, p-value=0.003, but diabetic patients undergoing diabetic management were found to be significantly less predicted (33.4%) to have presented with Higher blood cholesterol levels above normal range compared to Non-diabetic people in general, p-value=.030. From another side, people with lower than normal High Density Lipoprotein (HDL) were found to be significantly less predicted (34.3%

times less) to have presented with Higher than Normal (High Blood Cholesterol) cholesterol levels on average, p-value=0.016, denoting that people with low HDL tend to be less inclined to present with high cholesterol in general and by considering the other predictor variables in the analysis as accounted for in the analysis.

Low HDL

Table-7: Multivariable Binary Logistic Regression Analysis of the patients odds of having *abnormally Low* admission serum (HDL) fat level.

	Multivariate adjusted Odds Ratio (OR)	95% C.I.for OR		p-value
		Lower	Upper	
Sex=Male	1.044	.756	1.442	.795
Age (years)	1.007	.995	1.019	.244
Body Mass Index score	1.014	.990	1.039	.259
Mean Arterial (MAP) Blood Pressure	.999	.984	1.013	.847
Marital state=ever married	.632	.431	.925	.018
Nationality = African	1.098	.479	2.519	.825
Nationality =Asian	.857	.489	1.501	.589
Nationality = Indian/Pakistan	2.892	1.610	5.195	<0.001
Comorbid	1.490	1.257	1.767	<0.001
Mean Uric Acid throughout admission times	1.001	.999	1.004	.246
Constant	.132			.016

Dependent outcome variable= Low admission HDL Level (No/Yes)

Note: The other predictor variables and risk factors did Not correlate significantly with this outcome in the multivariate analysis

The multivariable Binary Logistic regression analysis of people's odds of presenting with less than Normal High Density Lipoprotein (Low HDL) was also considered, the yielded analysis findings showed that patients sex and age as well as their Body Mass Index and Mean Arterial Blood Pressure index did Not correlated significantly with their odds of presenting with Lower than Normal HDL levels, p>0.050 each respectively. However, people's marital state had correlated significantly but negatively with their odds of presenting with abnormally low blood HDL levels, ever married people measured significantly lower odds (36.8% times less) of presenting with low HDL compared to those who are Never married on average, p-value=0.018. Also, the yielded multivariate adjusted findings showed that both African and

Asian people may Not necessarily differ significantly from the Middle Eastern people with respect to their odds of presenting with abnormally low HDL levels, but people from Indian and / Pakistani origins were found to be significantly more predicted (2.892 times as higher) to present with abnormally low HDL levels compared to east Mediterranean's on average, p-value<0.001, see the mean barplot in Figure-D. Also, comorbid people were found to be significantly more inclined (1.449 times more or 44.9% times higher) to HDL blood levels below normal thresholds compared to those with No positive history of comorbidity, p-value <0.001. The patents serum Uric Acid upon presenting and their history of Uricemia did not correlate significantly with their odds of presenting with abnormally low blood serum high density lipoprotein levels, p-value=0.246.

High HDL level

Table-8: Multivariable Binary Logistic Regression Analysis of the patients odds of having High admission serum (LDL) fat level.

	Multivariate adjusted Odds Ratio (OR)	95% C.I. for OR		p-value
		Lower	Upper	
Sex= Male	1.562	1.043	2.342	.031
Age (years)	.990	.976	1.005	.179
Marital state= ever married	.514	.330	.802	.003
Nationality= Indian/Pakistani	2.317	1.205	4.454	.012
Nationality= Asian	1.858	.998	3.458	.051
Body Mass Index	1.028	.996	1.060	.083
Mean Arterial (MAP) Blood pressure	.997	.978	1.016	.761
Mean Serum uric acid level throughout admissions	.999	.997	1.001	.508
Constant	.280			.229

Dependent outcome variable= High admission LDL Level (No/Yes)

Note: The other predictor variables and risk factors did Not correlate significantly with this outcome in the multivariate analysis

The above table-8 displays the multivariable binary logistic regression analysis of the patients odds of presenting with higher than normal Low Density Protein at the outpatients clinics level. The resulted findings showed that male patients were found to be significantly more inclined to present with higher than Normal LDL (1.562) on average compared to female patients, p-value=0.031 , by accounting for the other predictor variables in the analysis .

However, patients age did not correlate significantly with their odds of presenting with above normal LDL, p-value=0.179, but their marital state had converged significantly on their odds of presenting with high LDL , ever married people were found to be significantly less predicted (48.58% times less) compared to people never married with respect to their odds of presenting with higher than Normal LDL levels , p-value=0.003 . Moreover, the multivariate analysis findings showed that Indian/Pakistani people residing in the Kingdome were found to be significantly more predicted (2.317 times more) to High LDL levels compared to Mediterranean and other (African) people , p-value=0.012, also people from Asian origins were found to be significantly more predicted to High LDL at present in time compared to Mediterranean and other people (African) , p-value=0.015 , note figure-D . Not only that but also peoples body mass index (BMI) had converged slightly positively, though not significantly , with their odds of presenting with an above normal LDL levels, p-value=0.083 . The patients mean arterial Blood pressure and serum uric acid levels did Not converged significantly on their odds of presenting with above normal LDL levels, neither did their history of hyperuricemia and the other measured factors converge on their odds of presenting higher than normal serum Low destiny lipoprotein when tested in other iterative analyses models.

Table-9: Multivariable Binary Logistic Regression Analysis of the patients odds of having High admission serum Uric Acid level.

	Multivariate adjusted Odds Ratio (OR)	95% C.I. for OR		p-value
		Lower	Upper	
Sex=Male	4.426	2.206	8.881	<0.001
Age (years)	.993	.971	1.016	.563
Marital state=Ever married	.422	.215	.831	.013
Body Mass Index score	1.004	.956	1.054	.875
Mean Arterial (MAP) Blood Pressure at admission	1.029	1.001	1.058	.043
Hypertensive on Treatment	2.270	1.159	4.444	.017
Positive History of Chronic Kidney Disease - CKD	11.316	4.324	29.615	<0.001
Mean serum LDL level	1.017	.969	1.067	.505
Serum HDL level	.996	.945	1.050	.879
Serum cholesterol level	.986	.940	1.034	.551
Serum Triglyceride Level	1.009	.988	1.032	.397
Constant	0.004			.005

Dependent variable= Higher than Normal Serum Uric Acide at admission (No/Yes).

To arrive at better understanding about what may explain why the patients in the sample had presented with lower/higher serum Uric Acid the multivariable logistic binary regression analysis was used. The resulted findings from the (MBLR) analysis showed that male patients were found to be significantly more predicted to present with above normal Uric Acid (4.426 times more) compared to female patients, p-value<0.001. Also, the multivariate findings suggested that people's age did not correlate significantly with their odds of presenting above normal uric acid, but their marital state had correlate significantly with their odds of higher than normal Uric acid, ever married people were found to significantly LESS predicted (57.8% times less) to High serum Uric Acid compared to those never married on average, p-value=0.013. Moreover, the analysis model suggested that people's Body Mass Index did not converge significantly on their odds of High uric Acid levels, but their mean arterial blood pressure (MAP) score had correlated significantly and positively with their odds of presenting with higher than normal serum uric acid, for each additional one mmhg rise in their mean

MAP the odds of their presenting with higher than Normal serum uric acid tended to rise by a factor equal to 1.017 times more (or 1.7% times higher) on average, p-value= 0.043 . Also, the resulted findings suggested that patients who are diagnosed with hypertension (HTN) that requires them to take treatments for high blood pressure were found to be significantly more predicted (2.27 times more) to present with High serum Uric Acid compared to patients who're non-hypertensive, p-value=0.017. Nonetheless, patients with Known positive history of Chronic Kidney Disease (CKD) were found to be significantly more inclined (11.316 times more) to present with higher than normal serum uric Acid compared to people not known to have chronic kidney disease on average, p-value<0.001. The multivariable adjusted findings suggested that neither of the patients measured serum lipids (LDL, HDL, cholesterol, and triglyceride) levels had correlated significantly with their odds of presenting with above normal levels of serum uric acid, p>0.050 each respectively.

Discussion:

The connection between dyslipidemia and hyperuricemia has not been clearly established in the literature. In this study, we performed a retrospective descriptive cross-sectional review of the medical records of patients with hyperuricemia who visited family medicine clinics over the course of a year (January–December 2019). We then looked at the relationship between dyslipidemia and hyperuricemia, using a base set of KKUH Clinics data from Riyadh, Saudi Arabia, to explain the connection between SUA levels and dyslipidemia. We discovered a strong correlation between SUA levels and dyslipidemia and its elements. These findings imply that the association between dyslipidemia and SUA levels may be influenced by age and gender.

Numerous research has demonstrated that some dyslipidemia-related factors, particularly HDL cholesterol, are not related to SUA levels. For instance, recent research on people of various ethnicities found a substantial connection between SUA levels and TG but not HDL cholesterol. Additionally, conflicting views regarding the relationship between uric acid and HDL cholesterol have been published (Cardoso AS, et al. 2013). Although other research had contradictory findings, our investigation found a positive correlation with each dyslipidemia-related factor, including hypertriglyceridemia, hypercholesterolemia, and low HDL-cholesterolemia. Our findings are in line with some prospective studies that found that dyslipidemia is significantly linked to an increased risk of developing MetS and that high SUA levels increase the chance of dyslipidemia (Zheng R, et al. 2017).

These findings also suggested that uric acid may play a role in the emergence of dyslipidemia. Numerous cardiovascular illnesses (CVDs), including hypertension and coronary heart

disease, have been linked to uric acid as a risk factor. Additionally, some clinical research revealed that treating hyperuricemia could improve the course of CVDs (Kuwabara M, et al. 2018). It is generally acknowledged that dyslipidemia and CVDs contribute to and influence one another. Consequently, patients with hyperuricemia may benefit from food management and uric acid level reduction to reduce their risk of dyslipidemia and other CVDs. This could be used to find patients who would advantage from safety measures to lower their risk of contracting diseases (Higgins P, et al. 2014).

Regarding gender differences, the majority of studies have revealed that human females do not exhibit the relationship between SUA and dyslipidemia. However, the connection was demonstrated in both male and female individuals in a different study. The connection between SUA levels and dyslipidemia was observed between postmenopausal but not premenopausal women in this study, which divided individuals into two groups by age 50, the average menopause age for Asian women. Techatraisak et al. reported comparable outcomes in postmenopausal Thai women. Therefore, the menopausal state may be responsible for the disparity between earlier researches (Shi J, et al. 2016).

According to various epidemiological studies, men have higher SUA levels than women do, and these levels rise after menopause. SUA levels may be impacted by estrogen's claimed effects on renal filtering, excretion, and reabsorption. Estrogen increases uric acid excretion and increases renal uric acid excretion in premenopausal women. Consequently, it is quite apparent that endogenous oestrogen is to blame for the lack of a connection between premenopausal women's SUA levels and dyslipidemia. To understand the mechanism underlying this phenomena, more research is required (Gao N, et al. 2016).

Conclusion / Recommendation:

We concluded that higher SUA levels were strongly associated with dyslipidemia and its components and that this association is influenced by age and gender for the first time. Further complementary studies regarding other lipid parameters are needed to confirm the accurate association between dyslipidemia and serum uric acid levels.

- To confirm the results, conduct additional research.
- Examining additional confounding variables that could have a significant impact on the findings.
- Examining more lipid profile characteristics and extending the scope of the study.

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