Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu

SUST
Journal of natural and Medical Sciences

Journal homepage: http://journals.sustech.edu/

Relationship of Serum Urate and Lipid Profile to Hemoglobin A_{1c}% among Sudanese with Type 2 Diabetes Mellitus

Mohammed E. Elhadi[1] and Badr eldien H. Elabid[2*].

Alhikma Medical Center, Khartoum - Sudan. Email.mo.elgezli@gmail.com

*Corresponding Author: Badr eldien H.Elabid, E-mail: dr.alabid@gmail.com

ABSTRACT

The aim of this study was to assess correlations between the serum levels of urate, lipid profile (total cholesterol, LDL- cholesterol, HDL- cholesterol and triglycerides) to Hemoglobin A_{1c}% among Sudanese with type 2 diabetic patients and to compare these variables with apparently healthy individuals as a control group. A case-control study was conducted during the period from Jan. 2011 to Nov. 2012 in Khartoum state among 150 Sudanese diabetic patients and 100 healthy controls for comparison. The serum levels of lipid profiles and serum urate were measured using chemistry analyzer (BS-200) and commercial kits from Biosystem company, Hemoglobin A_{1c}% analyses was performed using Nycocard reader II and commercial kits from Nycocard company, LDL-C was calculated using Friedewald`s Formula. The results of this study showed the means of the serum levels of total cholesterol, LDL-C, triglycerides and urate of the diabetic group to be significantly raised when compared to the control group, whereas the means of the serum levels of HDL-C of the diabetic group were significantly reduced when compared to the control group. The study showed weak positive correlation between the glycated hemoglobin and total cholesterol (r=0.20), LDL-C (r=0.36) and serum urate of the diabetic group (r=0.28) and very weak positive correlation with triglycerides (r=0.10) and also showed weak negative correlation between glycated hemoglobin and HDL-C in the diabetic group (r=0.32). From this study it had been concluded that the serum levels of total cholesterol, triglycerides, LDL-C and serum urate were significantly raised, whereas the serum levels of HDL-C were significantly reduced in Sudanese patients with type 2 Diabetes mellitus. HbA_{1c}% has a significant weak positive correlation with the serum levels of T. cholesterol, LDL and urate and has insignificant correlation with the serum levels of triglycerides and a significant negative correlation with the serum levels of HDL-C the results of this study, suggest a relationship between insulin resistance, and the metabolism of lipids and urate.

المستخلص

الهدف من هذه الدراسة هو تقييم العلاقة بين مستويات أملاح اليورات والدهون في الدم (الكولسترول الكلي، الكولسترول ذو الكثافة المنخفضة، الكولسترول ذو الكثافة المرتفعة وثلاثي الجلسريد) مع السكر التراكمي بين المرضى السودانيين المصابين بالسكري من النوع الثاني ومقارنة هذه المتغيرات مع أفراد أصحاء كمجموعة ضابطة، أجريت الدراسة خلال الفترة من يناير 2011 إلى نوفمبر 2012م في ولاية الخرطوم حيث شملت150 من المرضى السودانيين المصابين بالسكري من النوع الثاني و 100 من الأصحاء كمجموعه ضابطة للمقارنة. تم قياس مستويات الدهون

Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu

وأملاح اليورات في الدم بإستخدام جهاز التحليل الكيميائي (بي أس – 200) ومحاليل تجارية من شركة بايوسستم وتم جراء تحليل السكر التراكمي بإستخدام نايكوكارد ريدر ا ومحاليل تجارية من شركة نايكوكارد وتم حساب الكولسترول ذو الكثافة المنخفضة بإستخدام معادلة فريدوولد. أظهرت نتائج هذه الدراسة أن متوسطات مستويات مصل الدم للكولسترول الكلي، الكولسترول ذو الكثافة المنخفضة، ثلاثي الجلسريد، و أملاح اليورات لمجموعة السكري كانت مرتفعة وذات دلالة معنوية عند مقارنتها بالمجموعة الضابطة في حين كان متوسط مستويات الدم للكولسترول ذو الكثافة المرتفعة منخفضة وذات دلالة معنوية عند مقارنتها بالمجموعة الضابطة، الدراسة أظهرت ارتباط ايجابي ضعيف بين السكر التراكمي والكولسترول الكلي (معامل ارتباط = 0.20)، الكولسترول ذو الكثافة المنخفضة (معامل ارتباط = 0.36)، وأملاح اليورات لدى مجموعة السكري (معامل ارتباط = 0.28)، وارتباط ايجابي ضعيف جداً مع ثلاثي الجلسريد (معامل ارتباط = 0.10) كما كان هناك ارتباط سلبي ضعيف بين السكر التراكمي والكولسترول ذو الكثافة المرتفعة لدى مجموعة السكري (معامل ارتباط = 0.32). استُخلص من هذه الدراسة أن مستويات الدم للكولسترول الكلي، وثلاثي الجلسريد، والكولسترول ذو الكثافة المنخفضة وأملاح اليورات كانت مرتفعة وذات دلالة معنوية في حين كانت مستويات الدم للكولسترول ذو الكثافة المرتفعة منخفض وذو دلالة معنوية لدى المرضى السودانيين المصابين بالسكري من النوع الثاني، السكر التراكمي لديه ارتباط ايجابي ضعيف وذو دلالة معنوية مع مستويات الدم للكولسترول الكلي، الكولسترول ذو الكثافة المنخفضة وأملاح اليورات كما لديه ارتباط ليس له دلالة معنوية مع مستويات الدم لثلاثي الجلسريد ولديه ارتباط سلبي وذو دلالة معنوية مع مستويات الدم للكولسترول ذو الكثافة المرتفعة. نتائج هذه الدراسة تشير إلى وجود علاقة بين مقاومة الانسولين والتمثيل الغذائي للدهون واليورات.

Key words: *Insulin resistence, Dyslipidaenia, Glycated Hemoglobin*

INTRODUCTION:

Diabetes mellitus (DM) is a common endocrine metabolic disorder and a leading cause of death worldwide [1]. There are more than 154 million diabetics worldwide and its prevalence is on increase in the developing countries [2,3]. Certain racial and ethnic groups have a greater risk of developing diabetes. The majority of those that suffer from this disease are from Africa and Asia [4]. This may be due to genetic disposition and life style of people in these areas. Sudan being populous country in Africa may harbor a substantial number of people with this condition. Identifying risk factors for the development of type 2 diabetes is essential for its early Screening and prevention. Serum uric acid (SUA) level has been suggested to be associated with risk of type 2 diabetes. Biologically, uric acid (UA) plays an important role in worsening of insulin resistance in animal models by inhibiting the bioavailability of nitric oxide, which is essential for insulin-stimulated glucose uptake [5] The disease is accompanied in many cases by secondary alterations of protein and fat metabolism resulting in an array of physical disorders [6] The quantitative and qualitative abnormalities of lipids in diabetic patients are numerous. The most common abnormality found in diabetes is high triglycrides (TG) with low high density

Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu

lipoprotein (HDL), and although if low density lipoprotein (LDL) might not be higher, its metabolism is abnormal [7]. The HDL and LDL are The main two types of cholesterol, [8] which are related to life style factors such as diet and exercise [9]. Glycated hemoglobin (HbA_{1c} %) is a form of hemoglobin used primarily to identify the average plasma glucose concentration over prolonged periods of time. It is formed in a non-enzymatic pathway by hemoglobin's normal exposure to high plasma levels of glucose. Glycation of hemoglobin has been associated with cardiovascular disease, nephropathy, and retinopathy in diabetes mellitus. Monitoring the HbA_{1c}% in type 2 diabetic patients may improve treatment [10].

MATERIALS and METHODS:

In this study we have analyzed the serum levels of; triglycerides, T. cholesterol, HDL, LDL urate and HbA_{1c}% of 150 patients diagnosed with Type 2 diabetes mellitus as a test group and 100 apparently healthy individuals (non-diabetic) as a control group. All subjects involved in this study were recruited from Al Hikma Medical centre, Khartoum state. This study was carried out during the period from Jan. 2011 to Nov. 2012. The target population was Sudanese patient diagnosed with type two diabetes mellitus. Permission of this study was obtained from the local health authorities in the area of the study. Interviews were done to all participants to obtain the clinical data and to provide health education. Clinical assessments were done by a physician. The objectives of the study were explained to all individuals participating in the study. A Questionnaire was specifically designed to obtain information which helps in either including or excluding individuals in or from the study. 4 ml of venous blood were collected from each volunteer in this study, using local skin antiseptic (70%), disposable plastic syringe, and divided to plain containers and Edita containers. The samples in plain containers were centrifuged at 3000 rpm to obtain Serum.

Sample Analysis:

Blood samples were obtained from participants in fasting conditions serum. Triglycerides, urate, and T. cholesterol analyses were performed using chemistry Analyzer BS-200; HbA_{1c}% analyses was performed using Nyco-card reader 11, HDL analyses was performed using automated spectrophotometer, and LDL was calculated by the following Friedewald`s:

LDL-C = Total Cholesterol – Triglyceride
HDL-C =5

Statistical Analysis:

Statistical analysis of the results was done using SPSS. Data were presented as group (mean ± SD). Statistical significance was set up as $P < 0.05$. person's correlation and linear regression were used to asses correlation.

Quality Control:

The precision and accuracy of all method used in this study were checked each time in every patch and analyzed by including commercially prepared control sera, (normal and pathological human control sera), with analyzed values of serum level of triglycerides, T. Cholesterol, HDL, LDL, urate and HbA_{1c}%.

RESULTS:

In this study the serum levels of triglycerides, T. cholesterol, HDL, LDL, urate and HbA_{1c}% of 150 patients diagnosed with type 2 diabetes mellitus and 100 healthy controls, were estimated for comparison and to asses correlations of these variables with glycaemic control. The two groups were matched for

Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu

Variable	Test group n=150	control group n=100	P Value
S.Triglycerides mg/dl	117.2±36.2 (40 - 480)	98.5±32.4 (38 - 180)	0.003
S.T.Cholesterol mg/dl	177.8±37.3 (89-395)	161.3±33.0 (96-263)	0.000
S.HDL-C mg/dl	48.3±14.2 (15-91)	53.9±10.3 (28-77)	0.001
S.LDL-C mg/dl	105.2±34 (26-253)	87.5±25.5 (36-154)	0.00

age and sex. Strikingly, as shown in table 1, there was a significant difference between the means of the serum levels of triglycerides of the test group and the control group (mean ± SD): (117.2 ± 36.2) mg/dl versus (98.5 ± 32.4) mg/dl, respectively, p= 0.003. The mean of the test group was significantly raised. The same table also shows a significant increase of the mean of the serum levels of total cholesterol of the test group when compared to the control group (mean ± SD): (177.8 ± 37.3) mg/dl versus (161.3 ± 33.0) mg/dl, respectively, p= 0.000. Table 1 also shows a significant difference between the means of the serum levels of HDL of the test group and the control group (mean ± SD): (48.3 ± 14.2) mg/dl versus (53.9 ± 10.3) mg/dl respectively, p= 0.001. The mean of the test group was significantly reduced. The same table also shows a significant increase of the mean of the serum levels of LDL of the test group when compared to that of the control group (mean ± SD): (105.2 ± 34.0) mg/dl versus (87.5 ± 25.5) mg/dl respectively, p= 0.00. Table 2 shows that there is a significant difference between the means of the serum levels of urate of the test group when compared to the control group (mean ± SD): (6.2 ± 1.5) mg/dl versus (4.3 ± 1.2) mg/dl respectively, p= 0.020. The mean of the test group is significantly raised. The Table also shows a significant increase of the mean of the blood levels of HbA_{1c}% of the test group when compared to the control group (mean ± SD): (9.8±3.1)% versus (4.9 ± 1.8)% respectively, p= 0.000.

Variable	Test group n=150	control group n=100	P Value
S.Urate mg/dl	6.2±1.5 (2.9-8.5)	4.3±1.2 (1.9-7.8)	0.020
HbA_{1c}%	9.8±3.1 (5.2-22.2)	4.9±1.8 (3.1-5.7)	0.000

Table 1: Comparison of the means of the Serum levels of triglycerides, total cholesterol, HDL and LDL of the test group and the control group

Table 2: Comparison of the means of the Serum levels of urate and HbA_{1c} % of the test group and the control group.

Figures 1, 2 and 3 show significant weak positive correlations between the serum levels of total cholesterol, LDL-cholesterol and urate with HbA_{1c}%, wherease there was a significant weak negative correlation between the serum levels of HDL-cholesterol and HbA_{1c}% as shown in table (4). Figures 5 shows insignificant very weak positive correlation between the serum levels of triglycerides and HbA_{1c}%

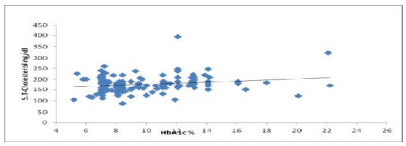

Figure 1: The relationship between the serum levels of T. Cholesterol and HbA_{1c}% in the test group (r= 0.20, p=0.013).

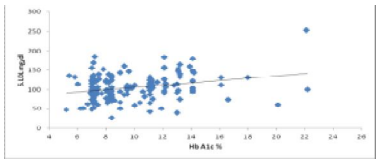

Figure 2: The relationship between the serum levels of LDL and HbA_{1c}% in the test group (r= 0.36, p=0.001).

Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu

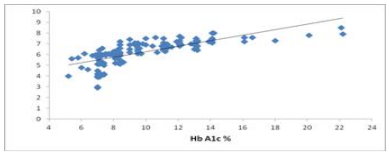

Figure 3: The relationship between the serum levels of Urate and HbA_{1c}% in the test group (r=0.28, p=0.021).

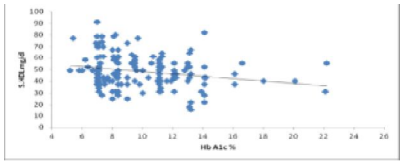

Figure 4: The relationship between the serum levels of HDL and HbA_{1c}% in the test group (r= -0.32, p=0.007).

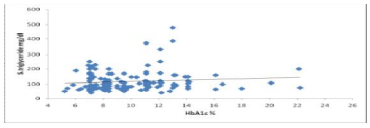

Figure 5: The relationship between the serum levels of triglycerides and HbA_{1c}% in the test group (r= 0.10, p=0.205).

DISCUSSION:

Patients with diabetes could have many biochemical changes including the serum levels of VLDL, HDL, LDL and triacylglycerols [11]. In the present study the results show that the mean of the serum levels of; triglycerides, T. Cholesterol and LDL in the diabetic group were significantly raised when compared with the control group, whereas HDL is significantly reduced in the diabetic group, when compared to the control group. These results agree with a study done by Riffat [12] who studied 14 patients with history of diabetes for 6-8 years, and reported that 8 had dyslipidaemia. Hyperglycemia leads to an increase in total cholesterol, LDL-C by reducing the ability of the body to remove cholesterol when blood sugars are too high. Total cholesterol and receptors for LDL-C in the liver coated with sugar (glycosylated), impairs the liver`s ability to remove cholesterol from blood stream, this could be due to the effect of diabetes on lipoprotein lipase in liver which leads to dyslipidaemia. This study reveals high prevalence of hyper cholesterolemia, hyper triglyceridemia, high LDL-C and low HDL-C levels which are well known risk factors for cardiovascular diseases. Insulin affects the liver apolipoprotein production, it regulates the enzymatic activity of lipoprotein lipase (LpL) and Cholesterol ester transport protein. All these factors are likely causes of dyslipidemia in Diabetes mellitus. [13] Moreover, insulin deficiency reduces the activity of hepatic lipase, and several steps in the production of biologically active LpL may be altered in DM. [14] Recognition of high S. urate as a risk factor for diabetes mellitus has been a matter of debate.[15] In Type 2 diabetes, hyperuricemia seems to be associated with the insulin-resistance syndrome, impaired glucose tolerance, and an early onset of nephropathy [16], Quiniones et al, [17] observed that, hyperuricemia is frequent finding in insulin resistant states. He found that insulin induces change in factional uric acid and sodium excretion co-related with one another and physiological hyperuricemia acutely reduces urinary uric acid and sodium excretion in diabetic patients. In the current study, correlation was studied between the lipid profile (T. Cholesterol, triglycerides, HDL-C, and LDL-C) and HbA_{1c}% in the diabetic group. The results showed insignificant weak positive correlation between the serum levels of triglycerides and HbA_{1c}% in the diabetic group. This result agrees with a study done by Erciyas et al, [18] who reported a positive correlation of HbA_{1c}% with triglycerides in diabetic patients. The results of the present study also show significant weak positive correlations between HbA_{1c}% and T. cholesterol, this result agree with Ram [19], Ohta et al, [20] and Erciyas et al,

[18] who also reported positive correlation of HbA_{1c}% levels with T. cholesterol in diabetic patients. The results also demonstrated a significant weak positive correlation between the serum levels of LDL-C and HbA_{1c}% in the diabetic group, this result agrees with Bhaktha [21], Erciyas et al, [18] Penbe et al, [22], and Habib [23] who reported a weak positive correlation between HbA_{1c}% and LDL-C (r=0.316). Similar results have been reported by Singh[24] who found a significant weak positive correlation between HbA_{1c}%, and the serum levels of T. cholesterol (r=0.29), triglycerides (r= 0.26) and LDL-C (r=0.16). These results are similar to that reported by Ohta et al [20] who found that HbA_{1c}% levels shows positive correlation with LDL-C and triglyceride in diabetic patients with type 2. The present study shows a significantly weak positive correlation between the serum levels of urate and HbA_{1c}% in the diabetic group, this result agrees with that reported by Zeina [25] who found a significant positive correlation between serum levels of urate and HbA_{1c}% in diabetic patients.

CONCLUSION:

From the results of this study, it is concluded that; serum urate and lipid profile are affected by insulin resistance in diabetic patients with type 2.

REFERENCES:

1. Faghilimnai, S., Hashemipour, M. and Kelishadi, B. (2006). Lipid profile of children with type 1 diabetes compared to controls. *ARYA. J.* **1:** 36 – 38.

2. Bennet, P. H. (2000). *Epidemiology of type 2 diabetes mellitus in: Diabetes mellitus*. Lekoith D, Taylor S. I, Olefsky JM. (eds.) 2nd ed. Wolter, New York. Pp. 544 – 557.

3. Sajjadi, F., Mohammadifard, N., Ghaderian, N., Alikhasl, H., Maghroon, M. (2005). Clustering of cardiovascular risk factors in diabetic cases in Isfahan province. 2000 – 2001: Isfan healthy heart program. *ARYA. J.* **2:** 94 – 100.

4. Manu, A., Shyamal, K., Sunil, G., Sandhu, J. S. (2007). A study on lipid profile and body fat in patients with diabetes mellitus. *Anthropologist* **4:** 295 – 298.

5. Khosla, U. M., Zharikov, S., Finch, J. L., Nakagawa, T., Roncal, C., Mu, W., Krotova, K., Block, E. R., Prabhakar, S., Johnson, R. J. (2005). Hyperuricemia induces endothelial dysfunction. *Kidney Int.* **67:** 1730 – 1742.

6. Welsh, M. C., Welsh, M., Ekman, J., Dixelins, R., Hagerkvist, R., Anneren, C., Akerblom, B., Menboobi, S., Chandresekharan, S., Liu, E. T. (2004). The tyrosine kinase FRK/RAK participates in cytokine-induced islet cytotoxicity. *Biochem. J.* 382. **15** (pt1): 261 – 280.

7. Chou, P., Li, C. L., Wu, G. S. and Tsai, S. T. (1998). Progression to type 2 diabetes among high-risk groups in Kin-Chen, Kinmen: exploringthe natural history of type 2 diabetes. *Diabetes Care*. **21:**1183–1187.

8. Khatit, M., Quazi, S. (2008). Canadian diabetes association which is related to life style factors such as diet and exercise, **17:** 103-109.

9. Khatit, M., Quazi, S. (2008). Risk factors of
type 2 diabetes mellitus in rural wardha: a community-based study. *International Joural
of Diabetes in Developing countries*.**9:**79–82.

10. Larsen, M. L., Horder, M., Mogensen, E. F. (1990). Effect of long-term monitoring of glycosylated haemoglobin levels in insulin-dependent

diabetes mellitus. *N. Engl. J. Med.* 323 **15:** 1021–5.

11. Haffner, S. M. (1998). Management of dyslipidemia in adults with diabetes. *Diabetes care*. 21: 9 **1**: 1600 – 1678.

12. Riffat. (2010). Impact of duration of type 2 diabetes mellitus on lipid profile. *Gomal journal of medical sciences*.**1:**57 – 59.

13. Goldberg, I. J. (1996) Lipoprotein lipase and lipolysis: central roles in lipoprotein metabolism and atherogenesis. *J. Lipid Res* **37:** 693-707.

14. Ko, G. T., Chan, J. C., Woo, J., Lau, E., Yeung. V. T., Chow, C. C. (1998) Glycated hemoglobin and cardiovascular risk factors in Chinese subjects with normal glucose tolerance. *Diabet Med***. 15:** 573-578.

15. Zietz, B., Herfarth, H., Paul, G., Ehling, A., Müller-Ladner, U., Schölmerich, J., Schäffler, A. (2003). Adiponectin represents an independent cardiovascular risk factor predicting serum HDL-cholesterol levels in type 2 diabetes. *Department of Internal Medicine I, University of Regensburg, D-93042, Regensburg, Germany*. **9:** 206-211.

16. Abdul, J. S., Rashid, M., Mudassir, A. (2002). Association of serum uric acid with type 2 diabetes mellitus. Department of Biochemistry and department of Physiology. *Khyber medical college, Peshawar.***13:**22-33.

17. Quiniones, G., A., Natali, A., Baldi, S., Frascerra, S., Sanna, G., Ciociara, D. and Ferrannini, E., (1995) Effect of insulin on uric acid excretion in Humans. *Am J Physiol*. 268 **1**: 1 – 5.

18. Erciyas, F., Taneli, F., Arslan, B., Uslu, Y. (2004). Glycemic con-trol, oxidative stress and lipid profile in children with type 1 Diabetes Mellitus. *Arch Med Res*. **35:**134-140.

19. Ram, V. M., Prajwal, G., Pramod, P., Prabin, G. (2011). Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin *as a* dual biomarker. *Biomedical Research*. 22 **3**: 375-380.

20. Ohta, T., Nishiyama, S., Nakamura, T., Saku, K., Maung, K. K., Matsuda, I. (1998). Predominance of

large low density lipoprotein particles and lower fractional esterification rate of

cholesterol in high density lipoprotein in children with insulin-dependent

diabetes mellitus. *Eur J Pediatr* **157:** 276-281.

21. Bhaktha, G., Nayak , B. S., Mayya, S., Shantaram, M. (2012). Is HbA_{1c} a risk factor for type 2 diabetic subjects without macro and micro vascular complications?. Department of Biochemistry, Yenepoya Medical College, Yenepoya University, Mangalore, Karnataka, India, **24:** 199-204.

22. Penbe, C., Belgin, S., Huriye, A., Ali. (2009). Effects of oral antidiabetic drugs over lipid parameters in Turkish type 2 diabetes patients. *Belgin Susleyici-Duman*, Marmara University, Science and Art Faculty, Biology Department, Istanbul, Turkey, **78:** 56-59.

23. Habib, S. and Aslam, M. (2004). Lipids and lipoprotein (a) concentrations in Pakistani patients with type 2 diabetes

mellitus. *Diabetes, Obesity and metabolism*. **6:** 338 – 343.

24. Singh, G. and Kumar, A. (2011). Relationship among HbA_{1c} and Lipid Profile in Punajbi Type 2 Diabetic Population. Department of Sports Science, *Journal of Punjabi University* Patiala. India, **11:** 305-311.

25. `Zeina, I. I. (2011). Correlation between Uric Acid and Liptin with Its Ratio in a Sample of Iraqi Patients with Diabetes Mellitus. *Journal of Al-Nahrain University Vol.14*. **3**, pp. 17-23-96.

Journal of Science and Technology vol. 14
ISSN 1858-6805
ESSN 1858-6813
Natural and Medical Sciences (NMs No.2)
mena@sustech.edu