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PREVALENCE OF METABOLIC SYNDROME COMPONENTS AMONG UNIVERSITY STUDENTS IN KENYA
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# PREVALENCE OF METABOLIC SYNDROME COMPONENTS AMONG UNIVERSITY STUDENTS IN KENYA

J. S. Malesi, N. G. Magak, M. G. Owiti and K. O. Onyango

## ABSTRACT

*Objective:* **To examine the prevalence and major components of MS among Maseno University students.**
*Design:* **Descriptive cross- sectional study design**
*Setting:* **Maseno University, Medical Physiology laboratory**
*Participants:* **429 participants were recruited from a target population of 17000 Maseno University students using stratified sampling technique.**
*Interventions:* **Socio-demographic data of participants were collected using a pretested questionnaire. Anthropometric parameters including Body Mass Index, Waist Circumference and biochemical parameters of triglyceride and high-density lipoprotein cholesterol were measured by following the World Health Organization guidelines. Blood pressure was measured in mmHg using automated Omron M2 blood pressure device and fasting blood sugar by use of a Hemocue blood glucose analyzer. Descriptive statistics was used to analyse the data.**
*Results:* **The MS prevalence among the University students was found to be 12.4%. The most frequently observed components were low High-Density Lipoprotein-cholesterol at 98.1% (males 65% and females 33.1%), fasting blood sugar (24.5%) and Body Mass Index ≥30kg/m$^2$ (4.9%). High Central obesity, high blood pressure and raised Triglycerides were observed less frequently (9.3%, 1.9% and 1.2% respectively).**
*Conclusion:* **MS prevalence is 12.4% and low High-Density Lipoprotein – cholesterol is the most prevalent component among the University students in Kenya.**

## INTRODUCTION

Metabolic syndrome (MS) is a constellation of risk factors including central obesity, insulin resistance, dyslipidemia and hypertension that makes a person vulnerable to developing cardiovascular diseases (CVDs) [1]. Also known as cardio-metabolic syndrome or syndrome X or insulin resistance syndrome, the condition is a threat to global public health due to its escalating incidence in both developed and developing countries [2]. The condition is rapidly increasing in prevalence and in association with the rising childhood obesity and sedentary lifestyles worldwide [1]. It is one of the risk factors for non-communicable diseases (NCDs), such as diabetes mellitus and cardiovascular disease, which are world's biggest killer diseases, estimated to cause 3.5 million deaths each year [1].

Worldwide, MS is a major health problem associated with increased morbidity and mortality which started as a characteristic of westernized societies but is now emerging as well in developing countries [3]. Available reports show that the prevalence of non-communicable disease is rapidly increasing around the globe where according to World Health Organization (WHO) estimates, by the year 2020, these diseases will account for approximately three quarters of all deaths in the developing world [4].

In Africa, the prevalence of metabolic syndrome is estimated to be between 17% and 25% [5]. However, in Kenya which is a rapidly developing country in Sub-Saharan Africa the extent of most cardiovascular diseases and the associated risk factors at population level remain largely unknown [6]. Chronic diseases have not received much attention due to over emphasis on communicable diseases, underreporting, missed diagnosis, misdiagnosis and misclassification of diseases [6]. However, it has been reported that NCDs contribute over one half of the top twenty causes of morbidity and mortality in Kenya. Total mortality attributed to NCDs in Kenya rose from 31.8% in 2002 to 33% in 2007 which has been attributed to urbanization that brings with it changes in lifestyle that adversely affect metabolism [6].

Several studies comparing the prevalence of MS in different populations reported varied prevalence rates with different frequencies of known MS components in different populations. Ahmed [1] established an overall 7.8 % prevalence of MS in Sudanese undergraduate students with Body Mass Index (BMI) greater than 30 $kg/m^2$ as the major component, Singh [7] established 34.3% prevalence with BMI of 30 $kg/m^2$ and hypercholesterolemia as major components in India. These varied prevalence rates of MS are the basis for which the current study was carried out to establish the prevalence and major components of MS among Kenyan University students; a case study of Maseno University population. Furthermore, few studies have analyzed the prevalence and major components of MS among university students with none having been conducted in Kenya, making the MS prevalence and major components unknown among Kenyan university students.

## MATERIALS AND METHODS

*Study site and recruitment of participants:* The present study was carried out at the department of Medical Physiology, School of Medicine in Maseno University, Western Kenya. The institution is one of the public universities in Kenya with undergraduate and postgraduate student population numbering

about 17,000. As a public University, Maseno admits learners from all the regions of the country and therefore, although the study population was youthful in age the individuals originated from different regions. Four hundred and twenty-nine (429) participants drawn almost equally from the university's 14 schools took part in the present study. Consecutive sampling technique was used to recruit at least 30 participants from each of the schools. Nine out of the total of 14 schools had 31 participants.

*Ethical Approval, Consenting and data collection procedures:* Ethical approval for this study was sought from Maseno University Ethical Review Committee and further permission sought from the Maseno University administration. The researcher also gave assurance to maintain confidentiality and sought informed consent from each participant before enrolment. Tests procedures and type of sample required for biochemical measurements were explained to the participant. Each participant was allowed 10 minutes rest after reporting to the study site before the onset of anthropometric measurements and five minutes after the anthropometric measurements before blood pressure measurement was taken. Blood for lipid profile and fasting glucose measurements was collected the next morning after a 9-12 hour overnight fast.

*Anthropometric Measurements:*

BMI (kg/m$^2$) and WC (waist circumference) were measured following the WHO diagnostic criteria. According to the WHO: a person is said to have MS if he has the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting blood glucose or insulin resistance, and any two of the following: Blood pressure ≥ 140/90 mm Hg, Dyslipidemia: triglycerides (TG) ≥ 150 mg/dl or low high- density lipoprotein cholesterol (HDL-C) < 35 m g/dl in men , HDL-C) < 39 m g /d l in women, Central obesity: waist : hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m$^2$, Microalbuminuria: urinary albumin excretion ratio ≥ 20 μg/min of albumin : creatinine ratio ≥ 3 0 mg /gm (7). Each participant's BMI was expressed as the ratio of weight in kilograms to height squared in meters (kg/m$^2$). Weight of the participants was measured using a seca weighing scale, without shoes and in light clothing. Height was measured using a seca rod 220 stadiometer (seca, Hamburg, Germany) without shoes. Both the height and weight were expressed to the nearest 0.1cm and 0.1kg, respectively. Waist circumference (WC) in centimetres was measured using a Roche waist circumference tape to the nearest 0.1cm with the subject standing upright with their feet comfortably apart, their weight evenly balanced on both feet and arms hanging by their sides, at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, with light clothes on. These measurements were taken by a qualified nurse serving at the Maseno University nursing skills room.

*Blood Pressure Measurement*

Blood pressure was measured by a qualified nurse using automated Omron M2 Comfort blood pressure device and recorded in mmHg. It was done after the study participants had rested for 5 minutes in a sitting position with the arm horizontally supported at the level of the heart. The measurement was repeated after 5 minutes and the average of the two measures was taken as blood pressure.

*Fasting Blood Glucose*

About 5ml whole blood samples were collected from each study participant by a qualified phlebotomist. A drop of the blood

sample was used to determine the individual's fasting blood glucose level using a hemocue 201 analyzer (Hemocue, Angelholm, Sweden) before the rest was immediately centrifuged and serum obtained in well labelled eppendorf tubes.

*HDL-c and Triglyceride*

The labelled serum samples were transported to Moi Teaching and Referral Hospital, Biochemistry laboratory in icebox for biochemical analysis of the Triglyceride (TG) level and high-density lipoprotein cholesterol (HDL-c) level based on the WHO diagnostic criteria using fully automated Cobas Integra 400 plus chemistry analyzer (Roche diagnostics, Switzerland).

- Study participants who had high measurements of pressure (≥ 140/90 mm Hg) and glucose were asked to repeat the tests and those that maintained the high levels were referred to a physician in the university clinic for treatment and further management. Those that had dyslipidemia, BMI > 30kg/m² and large waist circumference were also referred to an expert in the university health centre for education on appropriate intervention approaches.

## RESULTS

*Socio-Demographic Characteristics of Study Participants:*

**Table 1**

*Socio-demographic characteristics of study participants*

| Socio-demographics | Frequency (n) | Percentage (%) |
|---|---|---|
| **Age** | | |
| 18-20 | 173 | 40.3% |
| 21-23 | 142 | 33.1% |
| 24-26 | 9 | 2.1% |
| Over 26 | 105 | 24.5% |
| **Total (N=429)** | **429** | |
| **Gender** | | |
| Male | 282 | 65.7% |
| Female | 147 | 34.3% |
| **Total (N=429)** | **429** | |

Note. N represents total students sampled; n represents students per socio- demographic category. % obtained by $\frac{n}{N} \times 100\%$

The age bracket analysis showed that; 173(40.3%) were in the age bracket of 18-20 years; 142(33.1%) within 21-23; 9(2.1%) within 24-26 and 105 (24.5%) over 26 year

Prevalence of MS and the frequency of major components of MS; raised BMI, high blood pressure, low HDL-c, raised triglycerides, central obesity and raised fasting blood glucose among Maseno University students.

The study based on the WHO established that out of the 429 students sampled, 21 (4.9%) had a raised BMI of > 30 $kg/m^2$, 40 (9.3%) had a large waist circumference where 1 man had a waist circumference of over 102 cm and 39 women had a waist circumference of over 88cm, 5 (1.2%) had triglycerides of over 150 $mg/dl$, 421 (98.1% ) had a low HDL-c

count where 279 (65.0%) men had HDL-c of less 35 $mg/dl$ and 142 (33.1%) women had HDL-c of less 39 $mg/dl$ , 105 (24.5%) had high fasting glucose of over 110 $mg/dl$ and 8 (1.9%) had blood pressure above $\geq 140/90$ mm Hg.

**Table 2**

*Prevalence of MS components among university students*

| MS Component | Frequency (n) | Percentage (%) |
|---|---|---|
| **BMI (Kg/M²)** | | |
| $< 30$ | 408 | 95.1% |
| $> 30$ | 21 | 4.9 % |
| **Total (N=429)** | **429** | |
| | | |
| **Central Obesity (cm)** | | |
| $\geq 102$ in men | 4 | 0.9% |
| $< 102$ in men | 278 | 64.8% |
| $\geq 88$ in women | 36 | 8.4% |
| $< 88$ in women | 111 | 25.9 % |
| **Total (N=429)** | **429** | |
| | | |
| **Triglycerides (Mg/dl)** | | |
| $\geq 150$ | 5 | 1.2 % |
| $< 150$ | 424 | 98.8 % |
| **Total (N=429)** | **429** | |
| | | |
| **HDL-c (Mg/dl)** | | |
| $< 35$ in men | 280 | 65.2% |
| $\geq 35$ in men | 2 | 0.5% |
| $< 39$ in women | 142 | 33.1% |
| $\geq 39$ in women | 5 | 1.2 % |
| **Total (N=429)** | **429** | |
| | | |
| **High fasting glucose (Mg/dl)** | | |
| $\geq 110$ | 105 | 24.5% |
| $< 110$ | 324 | 75.5% |
| **Total (N=429)** | **429** | |
| | | |
| **Blood pressure (mm Hg)** | | |
| $\geq 140/90$ | 8 | 1.9% |
| $< 140/90$ | 421 | 98.1% |
| **Total (N=429)** | **429** | |

N represents total students sampled; n represents students per MS component. % obtained by $\frac{n}{N} \times 100\%$

**Table 3**

*Prevalence of MS among Maseno university students*

| MS Component | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| | **Glucose/Triglycerides/Waist circumference** | | |
| | **Male** (n= 50) | **Female** (n= 55) | Total (N =105) |
| **Age** | | | |
| 18-20 (n=30) | 0(0.0%) | 0(0.0%) | 0(0.0%) |
| 21-23(n=20) | 0(0.0%) | 0(0.0%) | 0(0.0%) |
| 24-26(n=0) | 0(0.0%) | 0(0.0%) | 0(0.0%) |
| Over 26(n=55) | 0(0.0%) | 1(1.9%) | 1(1.0%) |
| Total | 0(0.0%) | 1(1.9%) | 1(1.0%) |
| | **Glucose/HDL-c/Circumference** | | |
| **Age** | **Male** (n= 50) | **Female** (n= 55) | **Total** (N =105) |
| 18-20 (n=30) | 0 (0.0%) | 9(16.4%) | 9 (8.6%) |
| 21-23(n=20) | 0 (0.0%) | 0(0.0%) | 0 (0.0%) |
| 24-26(n=0) | 0(0.0%) | 1(1.8%) | 1 (1.0%) |
| Over 26(n=55) | 0(0.0%) | 3(5.5%) | 3(2.9%) |
| Total | 0(0.0%) | 13(23.6%) | 13(12.4%) |
| **Glucose/BMI/Triglycerides or Glucose/BMI/Blood pressure** | | | |
| **Age** | **Male** (n= 50) | **Female** (n= 55) | **Total** (N =105) |
| 18-20 (n=30) | 0(0.0%) | 0(0.0%) | 0.0% |
| 21-23(n=20) | 0(0.0%) | 0(0.0%) | 0.0% |
| 24-26(n=0) | 0(0.0%) | 0(0.0%) | 0.0% |
| Over 26(n=55) | 0(0.0%) | 0(0.0%) | 0(0.0%) |
| Total | 0(0.0%) | 0(0.0%) | 0(0.0%) |

*N refers to total students with high fasting glucose while n refers students with high fasting glucose per socio-demographic component. Overall prevalence (%) given by* $\frac{n}{N}\times 100\%$ *and prevalence by socio-demographic given by* $\frac{students}{n}\times 100\%$

## DISCUSSION

The most common components of metabolic syndrome in most populations include high blood pressure, high blood sugar, excess body fat around the waist and abnormal cholesterol levels. Classically these components tend to increase the risk of coronary heart disease, stroke and diabetes in the human population. The data presented in this report show a very low range; (0-1.9%) MS prevalence rates by gender and age among the university students when the parameters combinations were Glucose/Triglycerides/Waist circumference or Glucose/BMI/Triglycerides or Glucose/BMI/Blood pressure. However, with Glucose/HDL-c/Waist Circumference as the parameters combination, the study reported an overall MS prevalence rate of 12.4%. These findings suggest that high fasting blood glucose, low HDL-c and large waist circumference are the major MS components among University students and

therefore the most appropriate predictors of MS.

Several studies have reported that elevated levels of HDL-c are protective against coronary heart disease and the development of atherosclerosis [8,10,11]. This is because the main physiologic role of HDL is to mobilise cholesterol from the extra hepatic tissues for delivery to the liver for excretion. According to the US national cholesterol Education Program Adult treatment panel III guidelines an elevated level of HDL-c above 60mg/dl is a negative risk factor for coronary heart disease [12]. Randomized, controlled clinical trials have also provided addition evidence to this from a study that demonstrated that interventions that are geared towards raised HDL-c levels are associated with reduced coronary heart disease events. Low levels of HDL-c have also been collaborated with elevated risks of cardiovascular disease, coronary heart disease, myocardial infarction, stroke and Alzheimer disease [10]. These reports together with our findings lend support to the fact that low HDL-c can be one of the key indicators of MS. With low HDL-c, there is a high likelihood of impairment of the transport of cholesterol from the peripheral tissues to the liver thus leading to sustained high levels of cholesterol in circulation with concomitant predisposition to MS and hence coronary heart disease. In addition, evidence is available to show that the baseline HDL-c levels is always consistently and inversely associated with incident coronary vascular disease events [11,13] thus supporting our submission that low HDL-c can be used as a predictor of MS.

Regarding obesity and elevated levels of blood glucose [14] in their study reported that individuals with sustained hyperglycaemia and obesity exhibited a strikingly higher rate of conversion into diabetes and hence they are key components of metabolic syndrome. These two components have been associated with MS since both hyperglycaemia and obesity predisposes individuals to coronary heart disease and diabetes. The two are associated, since glucose can be metabolised into fat for deposition to the adipose tissues of the body thus contributing to obesity. The present study provides evidence to justify the use of hyperglycaemia and large waist circumference in addition to low HDL-c as indicators of MS. Therefore, any intervention strategy for the prevention of diabetes and cardiovascular disease must focus on these three components. The data of this study provides evidence for the use of hyperglycaemia, low HDL-c and large waist circumference for a guide to clinical or lifestyle approaches to the prevention of MS.

Females were at a greater risk of having MS with a prevalence rate of 23.6% compared to 0.0% in men. Also, females in the age bracket of 18-20 were at a greater risk with a prevalence rate of 8.6%. Previous studies indicate that highest prevalence in females could be attributed to poor dietary habits among female students that may involve consumption of excess carbohydrates and sugars and lack of physical exercise for purposes of maintaining body fitness [15]. The finding of 12.4% MS prevalence conformed to Nwegbu and Jaiyesimi [16] who established MS prevalence rates of 16.8% which is between 10% - 20%. Nwegbu and Jaiyesimi [16] had hypertension, obesity and low HDL-c as most common MS components. This study's prevalence rate of MS was higher than that of Ahmed [1] who had an overall prevalence rate of 7.8%, Feliciano-Alfonso [17], 2% using International Diabetes Federation criteria. The prevalence rate was also higher compared to that of Rutaihwa [18]

who had an overall prevalence rate of 0.2% and that of Odum & Orluwene [19], 10.9% using the WHO diagnostic criteria. However, this study's finding of an overall MS prevalence rate of 12.4% were lower than the studies conducted in Lebanon 31.2%, India 34.3%, Tanzania 25.6%, Saudi Arabia31.4% and Ethiopia 45.9% [3, 7, 5,20, and 21 respectively]. These variations might be due to differences in or could be attributed to differences in geographical location of the studies as well as socio-cultural variation of the study participant. Many cultures have different cuisines that can affect health. Western countries have diets high in saturated fats and carbohydrates compared to the Mediterranean cultures that have diets high in healthy fats with lots of vegetables. The variations may also be due to the different diagnostic criteria used to define metabolic syndrome. The present study used the WHO guidelines because in addition to the other components, it also includes BMI, microalbuminuria and insulin resistance. It was also noted that the finding of female students being at a greater risk of having MS compared to their male counterparts conformed to Ahmed [1] with raised BMI as the major MS component and Singh [7] who had raised BMI and hypercholesterolemia as components that increased MS risk. Further, the finding of high fasting glucose, low HDL-c and waist circumference as major MS components conform to the findings of Kagaruki [5], Feliciano–Alfonso [17], Sibai [3], Nwegbu and Jaiyesimi [16] who established reduced HDL-c, raised fasting glucose and large waist circumference (central obesity) as major MS components.

However, some of these studies focused on different population like adults, hospital workers and HIV patients unlike the other studies which focused on young adults in the universities.

## CONCLUSION

In conclusion the overall prevalence of MS was found to be 12.4 % with elevated glucose, low HDL-c/ and large waist Circumference being the main MS components.

## REFERENCES


1. Ahmed, A. M., Elabid, B. E., Elhassan, K. E., & Waggiallah, H. A. (2015). Metabolic syndrome among undergraduate students attending medical clinics for obligatory medical screening. *Tropical Journal of Pharmaceutical Research, 14* (2), 317-321.
2. Maxim, D.M. (2012). *Relationship of metabolic syndrome to physical activity in selected population of Mangalore (Unpublished Masters Proposal)*. Father Muller Medical College: Mangalore.
3. Sibai, A.-M., Obeid, O., Batal, M., Adra, N., Khoury, D. E., &Hwalla, N. (2008). Prevalence and correlates of metabolic syndrome in an adult Lebanese population. *CVD Prevention and Control, 3*, 83–90.
4. Öğüş, E., Tekindal, M. A., Ceylan, Y., Demirel, M., Emecioğlu, N., Ercan, İ., et al. (2013). Risks of metabolic syndrome in students of the faculty of health sciences. *Balkan Medical journal, 30*, 296-300.
5. Kagaruki, G. B., Kimaro, G. D., Mweya, C. N., Kilale, A. M., Mrisho, R. M., Shao, A. F., et al. (2015). Prevalence and risk factors of metabolic syndrome among individuals living with HIV and receiving antiretroviral treatment in Tanzania. *British Journal of Medicine & Medical Research* , 1318-1327.
6. Kaduka, L. U., Kombe, Y., Kuria, E., Bore, J. K., Bukania, Z. K., & Mwangi, M. (2012). Prevalence of metabolic syndrome among an urban population in Kenya. *Journal of Diabetes Care, 35*, 887-893.
7. Singh, A., Shenoy, S., & Sandhu, J. S. (2015). Prevalence of metabolic syndrome and its risk

factors among urban sikh population of Amritsar. *Journal of Postgraduate Medicine, Education and Research, 49* (1), 18-25.

8. Marz W., Kleber ME., Scharnagi H., (2017): HDL cholesterol: reappraisal of its clinical relevance. *Clin. Res. Cardiol.* (9) 663-75
9. Gordon DJ., Probstfield JL., Garrison, RJ., et al., (1989): High density lipoprotein cholesterol and cardiovascular disease. *Four prospective American studies circulation (1)*8-15
10. Abdolljalal Marjani, (2013): A review on HDL cholesterol alterations in metabolic syndrome; Journal of biological sciences. 13 (8): 679-684
11. Mora S, Burning JE, Ridker PM., Culy., (2011): Association of high density lipoproteins cholesterol with incident cardiovascular events in women by low-density lipoproteins cholesterol and apolipoprotein b100 levels: *A cohort study: Ann intern Med. 155*(11): 742-50
12. JAMA (2001)Extensive summary of the third report of the National cholesterol education program (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in Adults (*Adult treatment panel III). 285* (19) 2486-97
13. Nasreddine L., Naja, F., Tabet, M., Habbal, M. Z., Aida, E. A., Haikal, C., et al. (2012). Obesity is associated with insulin resistance and components of the metabolic syndrome in Lebanese adolescents. *Annals of Human Biology, 39(2*), 122-128.
14. Defina LF, Willis BL, Radford NB, Gao A, leonard D, Haskell WL, Weiner MF, Berry JD. (2013). The association between midlife cardio respiratory fitness levels and later life dementia: a cohort study. *An Intern Med*. 158:162-168
15. Mirhosseini, N.-Z., Yusoff, N. A., Shahar, S., Parizadeh, S. M., Mobarhen, M. G., & Shakery, M. T. (2009). Prevalence of the metabolic syndrome and its influencing factors among adolescent girls in Mashhad, Iran. *Asia Pacific Journal Clinical Nutrition , 18* (1), 131-136.
16. Nwegbu, M. M., &Jaiyesimi, O. O. (2012). Prevalence of metabolic syndrome amongst apparently healthy Nigerian adults in a hospital setting. *Journal of Medicine and Medical Sciences, 3* (1), 77-82.
17. Feliciano–Alfonso, J. E., Mendivil, C. O., Ariza, I. S., & Pérez, C. E. (2010). cardiovascular risk factor s and metabolic syndrome in a population of young students from the national university of colombia. *Rev Assoc Med Bras , 56* (3), 293-298
18. Rutaihwa, M. K. (2011). *Prevalence and risk factors of metabolic syndrome among students at the University of Dar-es-salaam (Unpublished masters' dissertation)).* Dar-es-salaam: Muhimbili University.
19. Odum, E. P., &Orluwene, C. G. (2013). Metabolic syndrome prevalence in healthy individuals in University of Port Harcourt Teaching Hospital (Upth), Port Harcourt. *Journal of Dental and Medical Sciences, 10* (3), 17-22
20. Barrimah, I. E., Mohaimeed, A. R., Midhat, F., & Al-Shobili, H. A. (2009). Prevalence of metabolic syndrome among Qassim university personnel in Saudi Arabia. *International Journal of Health Sciences, Qassim University, 3* (2), 133-142.
21. Tadewos, A., Ambachew, H., & Assegu, D. (2017). Pattern of metabolic syndrome in relation to gender among type-II diabetes mellitus patients in Hawassa University comprehensive specialized hospital, Hawassa, Southern Ethiopia. *Health Science Journal, 11*, 1-8.