

# The Association of Physical Activity and Diet with Metabolic Syndrome among University Students in Kenya

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## ABSTRACT

*The occurrence of these lifestyle related practices and dietary habits at early age has been shown to increase the predisposition towards metabolic syndrome. Metabolic syndrome refers to disorders occurring together resulting in an increase in the risk of diabetes and cardiovascular diseases. Prevalence rate was established at 1.9% indicative of occurrence of predisposing risks of metabolic syndrome in university students. A cross-sectional, quantitative research design was used. 323 participants were sampled from a population of 40,000 students with stratification according to the various school sizes. A self-administered questionnaire was used to collect data. 61.3% of the respondents did not exercise regularly, 72.3% snacked frequently, 60.6% of the subjects that were not diagnosed with metabolic syndrome were fit, 37.2% needed to work on their fitness while only 2.2% were out of shape. The relationship between sedentary lifestyle as a risk factor and metabolic syndrome was statistically significant, as was the relationship between dietary habits and metabolic syndrome. The study established that 85.4% of the subjects were not sure of the amount of calories they consumed in a day and 13.9% of the subjects reported they had weight issues that affected their academics. Modifications in lifestyle habits, physical activity and dietary composition can result in a positive impact on metabolic syndrome and its progression. A mandatory extra co-curricular program requiring students to participate in exercise and sports activities should be enforced to positively engage university students. Vulnerable groups such as the pre-hypertensive and obese should also be closely monitored.*

**Keywords:** Sedentary lifestyle, Dietary Habits, Metabolic Syndrome, Physical Activity.

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## 1. INTRODUCTION

Metabolic syndrome is comprised of a cluster of interrelated cardiovascular risk factors which result in an increased risk of diabetes, stroke, heart disease and mortality [1]. Previous studies have indicated its characterization as presence of any of the following; dyslipidemia, low high-density lipoproteins, glucose intolerance and insulin resistance, elevated blood pressure and abdominal obesity [2]. Following a rapid increase in sedentary lifestyle and childhood-teenage obesity, metabolic syndrome continuously develops into a public health concern [3]. Sedentary lifestyle, poor dietary choices and risky lifestyle choices are associated with obesity and other metabolic risk factors amongst teenagers and young adults in universities [4]. Early detection of risk factors is critical for commencement of directed interventions leading to reduction in the risk of progression to metabolic syndrome, coronary heart disease and diabetes. The choices made by university students on lifestyle and other activities like exercise are critical to their future health because they greatly impact each individual defining criteria. [5]. A lot of habits that are lifelong are developed during the university years and are likely to progress on to adulthood. Several scholarly works show that physical activity moderates several risks and diseases associated with metabolic syndrome [6,7,8]. Changes and modifications in lifestyle behavior patterns that include increase in physical activity and dietary changes can improve High Density Lipoproteins, triglycerides and elevated fasting glucose [9]. Genetics, ageing, lack of exercise and hormonal variations also have a causal effect but may defer depending on ethnicity [10]. Consumption of soft drinks is associated with an increased risk of developing adverse metabolic traits and eventually metabolic syndrome [11]. Early prevention of preceding risk conditions and emphasis on change in lifestyle eating behaviors and attention to exercise would reduce progression to metabolic syndrome and other cardiovascular conditions later in life. Emphasis on extra co-curricular activities for students and offering incentives such as sports scholarships as they pursue their academic education is a key intervention towards promotion of healthy living. Sedentary lifestyle is a major risk factor of metabolic syndrome and especially physical inactivity. Physical inactivity and lack of exercise results to increased

central adiposity, increased blood pressure and lipids. This is because muscle inactivity results in storage of lipids which would have been metabolized during physical exercise for energy production. IDF recommends exercises for at least 3 days per week for 30-40 minutes per day [10]. People who watch television or use computers for more than four hours in a day have twice the risk of metabolic syndrome (54%-94%) as compared to individuals who watched television or used computers for less than an hour every day [12].

Lifestyle interventions involving initiation of physical activity and diet results in significant weight loss and positive changes in metabolic risk factors [13]. Suggestions indicate that increased muscular strength upholds health through structural and metabolic changes resulting in an improvement of muscle sensitivity to insulin and the control of glucose levels [14,15,16]. A higher moderate to vigorous physical activity and sedentary time by children and adolescents was found to be associated with better prevention of metabolic risk factors without regard to amount of sedentary time by Ekelund et al. [17].

**1.1 Diet**

Overconsumption of calorie-dense, highly processed, nutritionally poor and rapidly absorbable foods has been shown to increase systemic inflammation and reduce insulin sensitivity. Chronic ingestion of this dietary pattern results in increased predisposition to metabolic syndrome [18]. Various studies have shown that MS results from a gradual and perpetual increase in insulin resistance throughout the body with close association with dietary carbohydrates and saturated fats resulting in elevated serum triglycerides and visceral adiposity [19].

Consumption of soft drinks, which is high among this population, is associated with an increase in prevalence and incidence of metabolic risk factors [11]. These soft drinks included sodas, energy drinks and processed juices. The findings from this study indicated a 48% higher prevalence of metabolic syndrome among participants who consumed one or more soft drinks per day pointing out the importance of diet as a predisposing factor to metabolic syndrome.

Modifications in exercise and diet are recommended as first line intervention in treatment of metabolic syndrome by the National Cholesterol Education Program (NCEP), and the American Heart Association (AHA). New lifestyle modifications in the management of metabolic syndrome should be vital public health priorities [18]

**2. METHODS**

This study sought out modifiable risk factors among students attending Mount Kenya University. Cross-sectional, descriptive and quantitative research design was employed. The university has a population of more than 40,000 students in 10 schools. 323 participants were recruited through word of mouth and classroom announcements, from all schools in the university’s main campus with stratification based on school size as indicated in table 1.

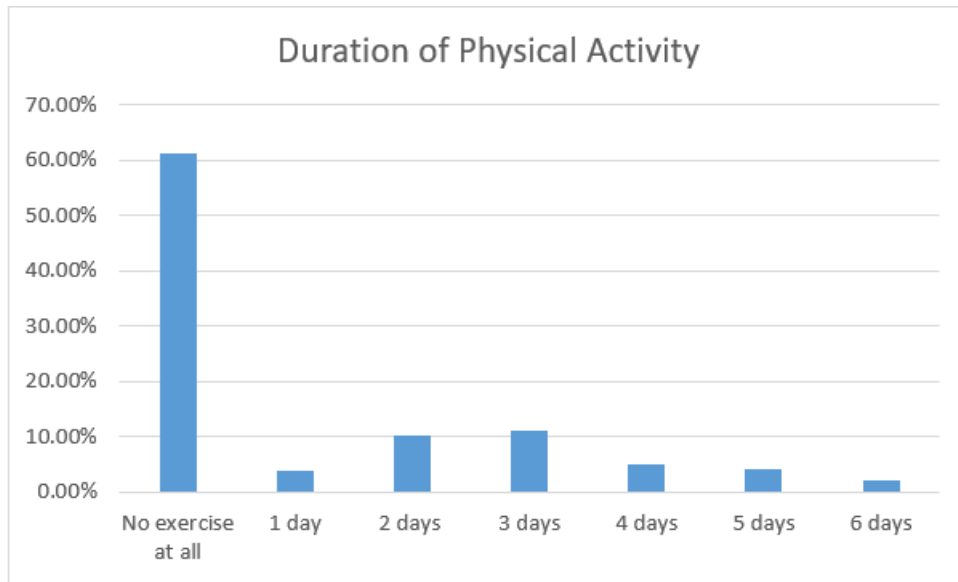
A self-administered standardized questionnaire with well outlined guidelines on response was used to collect data. It sought to assess the sedentary lifestyle practices, physical activity and dietary habits that predispose university students to metabolic syndrome.

**Table 1: Participant stratification per school**

School	Number of students	Frequency	Percent
School of Nursing	150	2	.6
School of Health sciences	4,638	40	12.4
School of Pharmacy	384	5	1.5
School of Social sciences	5,328	47	14.6
School of Education	10,735	93	28.8
School of Business and Economics	9,492	76	23.5
School of Pure and Applied sciences	6,907	60	18.6
Total	37,624	323	100.0

### 3. RESULTS

Published findings on one of the study objectives regarding prevalence of metabolic syndrome indicated a prevalence rate of 1.9% [20]. In regards to physical activity, the study established that a high majority of the subjects, 61.3%, reported they did not exercise regularly. (Figure 1)



**Figure 1: Duration of Physical Activity**

Around 15.8% of the respondents reported to be exercising one hour per day, 11.5% two hours per day, 5.9% less than an hour per day, 3.1% three hours per day, and 2.4% reported to be exercising more than three hours per day. This means that majority of students were not exposed to physical activity with close to two thirds of the subjects reporting lack of any exercise at all.

In regard to average sleep duration of the subjects, more than half (52.9%) reported a sleep duration of 7 to 8 hours, 31.3% 5 to 6 hours, 7.7% 9 to 10 hours, 4.6% 3 to 4 hours, and 2.5% reported a sleep duration of less than three hours and 0.9% reported a sleep duration of more than 12 hours. This means that the sleep duration distribution formed a normal curve since the two tails constituted a sum of less than 4%.

A cross tabulation done to establish the relationship between sleep patterns and six metabolic syndrome elements found no significant correlation between duration of sleep and any metabolic syndrome risk factor element. There was a strong correlation between physical activity and fitness levels as indicated in figure 2 and table 2.

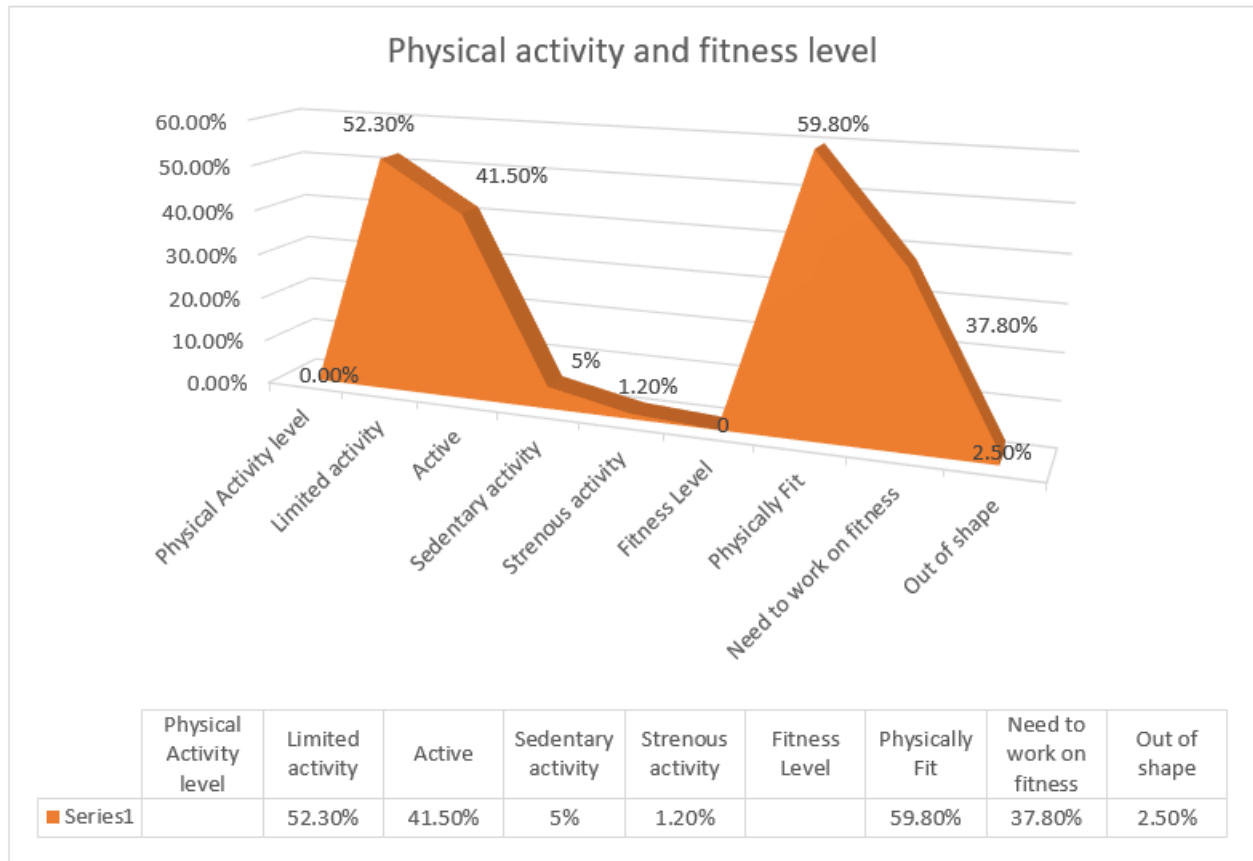


Figure 2: Comparison of Physical activity and fitness level

Table 2: Exercise and sleep patterns of participants

The respondent exercises regularly	Percent (%)
Yes	38.7
No	61.3
Total	100
Frequency of exercise in a week	Percent (%)
One day	3.7
Two days	10.2
Three days	11.1
Four days	5
Five days	4
Six days	1.9
Every day	2.8
Zero	61.3
Total	100
Duration of the exercise in a day	Percent (%)
Less than One hour	5.9
One hour	15.8
Two hours	11.5
Three hours	3.1
More than three hours	2.4
Zero	61.3

Total	100
Average duration of sleep	Percent (%)
Less than three hours	2.5
3 to 4 hours	4.6
5 to 6 hours	31.3
7 to 8 hours	52.9
9 to 10 hours	7.7
More than 12 hours	0.9
Total	100

### 3.1 Sedentary lifestyle

When asked about the diet and snacking habits, it was established that 72.8% of the subjects were snacking while the rest were not. From these group with a history of snacking, when asked the frequency of snacking, 38.7% of the subjects reported that they were snacking once a week, 26.3% were not snacking at all, 24.8% were snacking twice a week, 6.5% were snacking three times a week and 3.7% were snacking more than three times a week. It is worth noting that though close to three quarters of the subjects reported to snack, only 3.7% snacked more than three times in a week with another 6.5% snacking three times a week. Close to two thirds of the subjects reported to snack at most two days in a week. This means that the frequency of snacking among the subjects was low. (Table 3)

**Table 3: Activity, fitness and snacking habits**

Activity level of the respondent outside class	Percent (%)
Sedentary	5
Limited activity	52.3
Active	41.5
Strenuous	1.2
Total	100
Fitness level of the respondent	Percent (%)
Fit	59.8
Needs work	37.8
Out of shape	2.5
Total	100
The respondent snacks	Percent (%)
Yes	72.8
No	27.2
Total	100
Frequency of snacking by the respondent in a day	Percent (%)
Once	38.7
Two times	24.8
Three times	6.5
More than three times	3.7
Zero	26.3
Total	100
The respondent snacks while doing other activities	Percent (%)
Yes	59.4
No	40.6
Total	100

Out of 192 students who snacked while doing other activities, 20.8% watched television two hours in a day, 20.3% did not watch television at all, 16.7% watched one hour in a day, 14.1% watched three hours in a day, 10.4% watched less than one hour a day, 7.8% watched four hours per day, 5.2% watched five hours per day and 4.2% watched more than five hours per day. This means that most of the subjects who snacked while doing other activities watched television for a maximum duration of three hours per day with close to two thirds reporting so. A fifth of the students in this category did not watch television at all.

Majority of the students who snacked while doing other activities (61.5%) did not play video games at all, 14.1% played video games for a duration of one hour per day, 12.5% played for less than one hour per day, 8.3% played two hours, 1.6% played 4 hours, 1.0% played 3 hours, 0.5% played five hours same as more than 5 hours per day. This result indicates that only a quarter of the students in this category played video games for at least one hour per day with close to two thirds not playing video games at all.

From the research findings, it was established that of the subjects who snacked while doing other activities, (33.9%) did not work on a computer, 18.8% worked on a computer two hours per day, 16.1% for one hour per day, 11.5% for less than an hour, 7.3% for three hours, 4.7% for five hours per day same as more than five hours and 3.1% worked on a computer four hours per day. This result indicates that slightly above half of the students who snacked while doing other activities worked on a computer at least one hour per day pointing at a possible relation of snacking habits and computer usage with sedentary lifestyle occurrence and predisposition to metabolic syndrome.

In regard to listening to music among students who snacked while doing other activities, 20.8% said they did not listen to music at all, 18.8% reported they spent two hours per day listening to music, 18.2% for one hour, 13.0% for three hours, 9.9% for less than one hour, 8.3% for more than five hours, 5.7% for five hours, and 5.2% of the students who snacked while doing other activities reported to be spending four hours per day listening to music. This result indicates that two thirds of the students who snacked while doing other activities spent at least one hour a day listening to music.

The study established that 18.8% of the students who snacked while doing other activities spent three hours per day sitting and chatting on the phone, 17.7% spent more than five hours, 15.6% for two hours, 13.5% for one hour, 12.0% for four hours, 8.9% spent five hours same as less than one hour and 4.7% of the said students did not sit and chat on the phone. This result indicates that close to 90% of the students who snacked while doing other activities spent at least one hour per day sitting and chatting on the phone. It is worth noting that less than 5% of the students in this category did not sit and chat on the phone.

Out of the five selected activities, sitting and chatting on the phone was the most prevalent among students who snacked while doing other activities followed by listening to music and watching television respectively. Playing video games was the least prevalent.

Chi square statistics was done to test the null hypothesis that sedentary lifestyle and dietary factors are important risk factors of metabolic syndrome. Of the six subjects that were diagnosed with metabolic syndrome only one was fit. Four needed to work on their fitness while one was out of shape. It is paramount to note that 60.6% of the subjects that were not diagnosed with metabolic syndrome were fit, 37.2% needed to work on their fitness while only 2.2% were out of shape. The relationship between sedentary lifestyle as a risk factor and metabolic syndrome was statistically significant, ( $\chi^2 = 8.221$ ,  $df=2$ ,  $p=0.016$ ).

### **3.2 Diet**

78.0% of the subjects reported their nutritional status as average, 10.8% very good, 8.4% poor, 2.5% excellent and 0.3% very poor. This result indicates that the nutritional status of the subjects was not good since less than 15% reported their nutritional status as either very good or excellent. In regard to eating habits, 68.1% reported that their eating habits was fair, 22.6% good and 9.3% of the subjects reported that their eating habits was poor. This result means that the eating habits of the students was not good since only slightly above a fifth said they had a good eating habit.

The study established that 85.4% of the subjects were not sure of the amount of calories they consumed in a day, 11.8% knew roughly how many calories they consumed in a day and 2.8% knew exactly how many calories they took in a day. This indicates that most of the subjects were not sure of the amount of calories they consumed in a day with only less than 3% reporting that they knew exactly how many calories they took in a day.

About 13.9% of the subjects reported they had weight issues that affected their academics. This means that most of the subjects did not have weight issues affecting their school work since more than four fifths of the subjects reported so. Approximately 4.6% of the subjects had weight concerns that affect their academics almost daily, 3.7% few days, 3.1% rarely and 2.5% of the subjects reported they had weight concerns affecting their academics daily. Around 52.6% of the subjects reported they were not satisfied with their current weight. A majority of the subjects (61.3%) reported to be taking three meals in a day, 29.1% two meals, 5.9% more than three meals and 3.7% of the subjects reported to be taking one meal in a day. This means that most of respondents took

three meals per day as indicated by close to two thirds of participants. Of the six subjects that were diagnosed with metabolic syndrome, three always took fast food and another three often took fast food. The relationship between dietary habits as a risk factor and metabolic syndrome was statistically significant, ( $\chi^2 = 39.881, df=4, p=0.000$ ).

**Table 4: Dietary habits in university students**

Nutritional status of the respondent	Percent
Very poor	0.3
Poor	8.4
Average	78
Very good	10.8
Excellent	2.5
Total	100
The respondent has had weight concerns	Percent
Yes	53.6
No	46.4
Total	100
Eating habit of the respondent	Percent
Poor	9.3
Fair	68.1
Good	22.6
Total	100
Dietary habit of the respondent while at school	Percent
Eat fast foods	24.1
Eat cooked meals in the school cafeteria	40.9
Skip meals	35
Total	100

#### 4. DISCUSSION

With close to two thirds of the participants revealed as lacking any physical exercise, the findings correlate with Diehl et al. [21] who looked at the physical activity among university students as they transition from school to university. The findings also agree with Salonen et al. [14] who indicated that an increase in the volume and total mean intensity of physical activity was associated with a reduced possibility of metabolic syndrome. Clement et al. [22] while looking at the physical activity in university students in Portugal contradict findings from this study with students reportedly complying with the physical activity recommendations.

This study indicates that more than half of the respondents were physically inactive which correlates with findings from Awadalla et al. [23]. Hajian-Tilaki et al., [24] and Salonen et al., [14] however are in contradiction with their findings reporting a moderate to vigorous activity in more than 60% of participants and 90% respectively. Most of the respondents' perception of their eating habits indicated a general unhealthy inclination. This correlates with findings from Deliens et al. [25] while looking at the determinants of eating behavior in university students. The study findings established that there is a statistically significant relationship between sedentary lifestyle as a risk factor to metabolic syndrome. Similarly, there is a significant relationship between dietary habits as a risk factor and the prevalence of metabolic syndrome. The findings echo those of Tope & Rogers [9]; Fernandes et al. [5]) and Huang et al. [26] who note that sedentary lifestyles and poor dietary habits are risk factors to development of metabolic syndrome. The study by Jahangiry et al. [27] concluded that there was a positive outcome of a web-based lifestyle intervention program focusing on physical activity and dietary habits. Because of high and increasing rates of overweight/obesity and a growing concern of metabolic syndrome, university students are at an ever increasing risk of developing chronic diseases that include cardiovascular disease and diabetes mellitus. This is echoed in the study by Arts et al. [28].



## 5. CONCLUSION

The results indicate a significant relationship between sedentary lifestyle and metabolic syndrome. This significance is also noted between dietary habits and metabolic syndrome. Most of the habits that develop during this period in the university are lifelong. Modifications in lifestyle habits, physical activity and dietary composition can result in a positive impact on metabolic syndrome and its progression. A mandatory extra co-curricular program requiring students to participate in exercise and sports activities should be enforced to positively engage university students. Vulnerable groups such as the pre-hypertensive and obese should also be closely monitored. Pre-admission screening for 1st years to identify at risk students should be conducted. This would allow at-risk students such as those with hypertension, risk of cardiovascular diseases, and obesity to be identified as at risk in medical files. Health workers within the school health departments should monitor the at-risk through frequent routine check-ups based on the pre-admission screening results. This study offers unique insight into the sedentary lifestyle and dietary habits of university students including the association of these modifiable risk factors with the occurrence of metabolic syndrome. It also presents vital knowledge essential in the development of early targeted interventions aimed at prevention of metabolic syndrome and sustained healthy living among university students.

## Conflict of Interest

The authors declare no competing interests.

## Acknowledgements

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